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The contract for a new water supply for Jersey City has not yet been awarded, although proposals (see Eng. News, March 28, 1895) have been under consideration since March 25. Various propositions have been made since the formal bids were received. The latest of these was submitted on April 15 by Woltman, Keith & Co., of 11 Wall St., New York city. The drainage area which this company proposes to draw upon is practically identical with that described in a communication from Mr. C. C. Vermuele, published elsewhere in this issue, and the character of the works is similar. The price at which Woltman, Keith & Co. offer to furnish water is $42.50 per million gallons daily up to 20,000,000 gallons, and a diminishing amount for an increasing consumption until $30 is reached as the unit price for 50,000,000 gallons. The city would have the option of buying the works for $6,000,000. All these figures are based on two 25,000,000-gallon supply mains. If one 50,000,000-gallon main were used the prices would be reduced, but to what extent is not stated.

A ship canal is proposed from Elliott Bay to Lake Washington, in Washington state, by way of Smith's Cove and Lake Union, and the Washington Dredging & Improvement Co., of Seattle, Wash., has been organized, with a capital stock of $3,000,000, by W. Morrison, William Hayes and Frank Shay, to carry out this work, and also fill the tide flats of Smith's Cove.

The connection by canal of the Black and the Caspian seas is again interesting Russian engineers. According to one plan, the Volga would be used as a waterway to Tsaritzin, and from there a 53-mile canal would be dug to the River Don, connecting with the Sea of Azov. The highest point on the canal would be about 200 ft. above sea level. There would be 21 locks, and vessels of 500 to 600 tons could pass in 70 hours, and smaller vessels in 24 hours. The estimated cost is $14,000,000. The other plan is to use the River Don as far as the mouth of the River Maulsch, and follow the latter river with a canal, cross the watershed between the two seas and pass down the Kara River to the Caspian Sea. The one drawback to all these schemes is the fact that the Sea of Azov is so shallow that it will only admit vessels up to 15 ft. draft.

The bill providing for an increased tax levy upon the Sanitary District of Chicago, recently introduced in the Illinois Legislature, at the instigation of the Trustees of the District, has received a setback in the Senate Committee, and the substitute bill, drawn up in the interests of the people of the Des Plaines and Illinois rivers valleys, has been reported favorably. The conditions which led to the introduction of the Drainage Trustees' bill was outlined in our issue of Feb. 21, 1895. This bill called for power to raise the present tax levy of 0.5% to 1.5% for a period of three years. The substitute bill increases the period during which the tax is to be levied to six years, and requires the main channel to be continued from its present terminus above Lockport, Ill., to the basin above Joliet, Ill., at an expense of about $6,000,000, and also requires the construction of swing bridges instead of temporary fixed bridges. The basis on which these claims are made is that the intention of the original bill was to provide a navigable channel, and to secure a flow of 600,000 cu. ft. of water per minute, and that the Trustees of the District are not acting in good faith with respect to these provisions.

Late surveys on Galveston bar show a depth of 16¾ ft. at mean low-tide. The survey of a month ago showed 16 ft. on the bar and a distance of 400 ft. across the bar between the two 18-ft. curves. Major Miller, of the Corps of Engineers, U. S. A., says the deepening is progressing very satisfactorily and a noticeable point is the persistency shown by the channel to cut out and widen in the direction in which it has started. Work is to be hastened by dredging upon the bar.

The Gillies contract for the new Brooklyn dry-dock has been annulled by Secretary Herbert, of the U. S. Navy Department. New bids are asked for on April 29, as the Department will require the dock at the earliest possible moment. Bidders had official permission granted ten days ago to enter upon and measure the work already performed by Gillies.

The American Line steamer "St. Paul" was successfully launched at Cramps' yard at Philadelphia on April 10. Her sister ship, the "St. Louis," is almost ready to go into commission on the line between Southampton and New York.

A serious lock accident is reported as happening on the Manchester ship-canal on April 10, though details are still wanting. It is said that the steamship "Harold," in entering the Latchford locks, struck and carried away the two lower gates and then dropped 16 ft. into the lower level, seriously damaging the vessel. The upper gates were quickly secured by cables and the water prevented from escaping from the upper level. The Latchford locks are 15 miles from Manchester and are the fourth in the series of locks counting from that city. These locks communicate directly with tide-water in the Mersey River, with a difference of level of 16½ ft. at ordinary high-water.

The most serious railway accident of the week was caused by a runaway excursion train on the Ohio Valley R. R., at Evansville, Ind., April 15. The train was entering the Evansville & Terre Haute R. R. yards when the engineman found the brakes would not work, and the engine was wrecked by colliding with a heavy bumper. The passengers were badly shaken up, but nobody was killed or seriously injured. ——A fast train on the Chicago & Alton R. R. ran over a handcar near Marshall, Mo., April 12, killing three men.

The dam of the Utica Mining Co., at Angels Camp, Cal., broke April 12. The dam cost $140,000.

The roundhouse and machine shops of the Atlantic & Pacific R. R., at Winslow, Ariz., were burned April 8, and eight locomotives were destroyed.

Spring freshets and floods have caused considerable damage throughout New England, washouts having occurred on several railways, and highway bridges being carried away at Canton, Hanover and Cherryfield, Me., and other places. Two dams on the Narragagus River, Maine, have been washed out. In New Jersey the Delaware River flooded towns and stopped work at mills, overflowed the Delaware and Raritan Canal, carried away several buildings, and caused washouts on the railways.

A new business block on Main St., Syracuse, N. Y., collapsed April 16, two men being killed and two injured by the falling walls.

The dam at Fairfield's reservoir at Keene, N. H., gave way April 9, a gap of 30 ft. wide being caused by the water. Some of the streets were badly washed by the flood.

Electricity was lately used in Philadelphia as a weapon of offence in a contest between two rival trolley companies, the Philadelphia and the People's Companies. The first-named company desired to extend its line across Girard Ave. bridge, and was authorized to use the track of the other company for this purpose. But the People's Company denied the right of the Philadelphia corporation to use anything but the rails, and in the fight between the workmen that followed wires were cut and the live end of one was laid over the wires of the Girard Ave. line, severely shocking some of the men. The contest is to be settled in the courts.

The first 5,000-HP. dynamo of the Niagara Falls Power Co. has been installed, and was first set in motion on April 6. Newspaper reports have generally stated that the machine was tested on that date, with satisfactory results; but more authentic accounts state that the shaft was merely set in motion at a speed of 32 revolutions, its rated speed being 250, and no current was generated, the fields not being excited.

Sixteen 12-in. rifled mortars and a 10-in. and a 12-in. gun, on disappearing carriages, were successfully tested at Sandy Hook on April 10. The mortars were in a regular sunken battery, arranged in groups of fours. The projectiles were made of steel, were 3½ ft. long and weighed 800 lbs. each; the service charge was 80 lbs. of powder. At the 6,000-yd. range over the sand beach, the sixteen projectiles were found considerably within a circle of about 1,300 ft. diameter; and at the 3,000-yd. range the accuracy was greater still. The Gordon disappearing carriages worked admirably. The 10-in. rifle was fired with a charge of 270 lbs. of brown prismatic powder, a projectile of 575 lbs. and at an elevation of 5°. Two very successful shots were made, the second with the muzzle depressed so that the shot struck the water 400 yds. away. The 12-in. gun was also tested on its disappearing carriage by firing out to sea. The mortar battery, in its sunken pit, and the two heavy guns, in pits of concrete 50 ft. thick, backed by as much earth, form part of the new defences of New York harbor.

A 13-in. semi-armor piercing nickel-steel shell was tested at Indian Head on April 10, the first of a series of tests. This shell passed through a 7-in. nickel-steel plate without exploding or exposing the contained powder charge. The second shot was with a percussion shell. This passed through a screen and burst 10 or 12 ft. beyond, as desired. The test was highly successful, as one of the same shells passed through a 2-in. steel plate and burst on the other side.

The plans for the six gunboats, authorized by the last Congress, are nearly completed. These boats will have full sail power, and a great amount of deck space adapted to quartering people having occasion to seek the protection of naval vessels. The funnels will be the loftiest on any man-of-war, being nearly as high as the military masts on some of our cruisers. In regard to the two battle-ships ordered by the same Congress, the ordnance and construction officers differ as to the armament. The former wish to use two 13-in. rifles in the two turrets, contending that they have 30% more power than the 12-in. guns, and will not only penetrate the heaviest armor, but wreak destruction behind this armor. What they want is ordnance capable of delivering a smashing blow. The construction bureau says that the adoption of 13-in. instead of 12-in. guns will mean an increase in length and beam in the ship and an additional displacement of 1,000 tons, or a 12,000 instead of the 11,000-ton ship proposed by Congress. More engine power would also be needed. As Congress placed no absolute limit on the displacement of the new ships, there is likely to be a lively fight between the two bureaus as to the appropriate ordnance. The plans for the three torpedo-boats ordered vary but little from those bid upon recently, but the engine power will probably be increased so as to give a minimum of 25-knot speed on a four-hour trial.

The Boston subway project is meeting with considerable opposition, chiefly on the grounds that the estimate of $5,000,000 will not meet the actual cost, and that it may destroy some of the trees on the Boylston and Tremont St. malls. The opposition ask that the whole subject be resubmitted to popular vote. Meanwhile, the friends of the project are just as active in setting forth the good points of the subway and correcting misstatements of fact.

A subway is to be built at Erie, Pa., to carry Ash St. under the railway tracks, the necessary arrangements having been made between the city and the Lake Shore & Michigan Southern Ry. and the Philadelphia & Erie R. R. (Pennsylvania R. R.). The subway will be 30 × 12 ft., with a roadway 20 ft. wide and sidewalks 5 ft. wide. There will be fifteen girder bridges, 34 ft. 3 ins. long. The subway work, excavation, masonry and bridges will be done by the railways, and the city has appropriated $9,000 for its share of the work, or about one third of the total cost. This will be an important improvement, being the first street put under the tracks which divide the city in half and have caused great inconvenience to street traffic as well as many accidents. The intention is to eventually extend this improvement to all other streets running north and south and crossing the tracks. The original plans and estimates were prepared by Mr. George Platt, City Engineer, though the railway companies will have charge of the work under the arrangement between them and the Councils. The descending grade for the subway from 15th St. to the tracks is 5½%, and the rate of ascending grade from the tracks to 18th St. is 1.9%.

STANDARD TESTS OF PAVING BRICK.

By J. B. Johnson, M. Am. Soc. C. E.*

Probably tests on no other kind of engineering materials are so significant and valuable as those made on paving brick. Up to this time, however, there has been no recognized standard method of making these tests, and hence no comparison can be made, as a rule, between tests which have been made by different persons or even between tests made by the same person at different times. At the last meeting of the American Brick Manufacturers' Association,a committee was appointed to report a standard method of making such tests. As the writer has had a large experience in making tests of paving brick, he contributes the following views on the subject, hoping they will prove of some service in finally fixing upon a standard method of making these tests.

The present custom of testing the brick in four ways is, I believe, a good one, and should be maintained. These tests are (1) for cross-breaking strength,(2) for crushing strength,(3) for abrasion (or impact), (4) absorption. I will discuss these tests in detail, indicating my views as to the significance of the tests, and how they should be made.

Preparation of Specimens.

For both the cross-breaking and the crushing tests, it is absolutely essential in my opinion, to have the bearing surfaces which are used in these tests polished to true parallel planes. The results of the tests which I have made proved conclusively that it is only in this way that the full strength of the brick could be developed. I consider this as essential in the cross-breaking test as in the crushing test. For paving brick there is no question about which surfaces should be chosen as the bearing surfaces in these tests. Both these tests should be made upon the brick as it rests in the street, that is to say, edgewise. Hence, the surfaces to be polished are the top and bottom surfaces as laid in the street, these being the faces whose dimensions are approximately $2\frac{1}{2} \times 8$ ins.

Before these surfaces can be polished to parallel planes, it is necessary to true up one flat side to serve as a plane of reference. This polishing can only be done in a proper manner on stone polishing tables, operated by machinery. I consider this requirement absolutely essential, if the true strength is to be developed. Brick tested in this way will show a strength from 25 to 100% greater than can be obtained with rough specimens, even though these be given true bearings on plaster of paris, as has been a common practice hitherto.

Cross-Breaking Test.

This test should be made by setting the brick edgewise on rounded knife-edges 7 ins. apart, and loading at the center by a rounded knife-edge until it breaks. It was formerly the custom to deduce from this test the tensile strength of the brick in pounds per square inch from the following formula:

$$f = \frac{3}{2} \frac{W l}{b h^2}$$

Wherein,

f = tensile strength in pounds per square inch
W = breaking load.
l = length between bearings.
b = breadth of specimen.
h = height of specimen.

The objections to this method of reducing the results of the cross-breaking tests are that it gives a result which is understood only by scientific men, and furthermore gives no advantage to the deeper brick. If one kind of brick is 10% wider than another, it is thereby 20% stronger than the other; and yet when computed by the above formula, this advantage would not be shown. It is the writer's practice to divide the breaking load obtained by this test by the breadth or width of upper surface of the brick as it is laid edgewise on the street. This gives the breaking load per inch in width, and allows to the deeper brick its proper advantage. This also is a result readily understood by practical men ,and is a kind of index of the strength of the pavement to resist concentrated loads without breaking across. The real strength of a brick when laid on a sand cushion in the street and uniformly supported underneath, would be something more than twice the strength shown by this test in the testing machine. That is to say, if a brick $2\frac{1}{4}$ ins. wide on its upper face carries a load at its center of 9,000 lbs. on a 7-in. span, this would show a strength of 4,000 lbs. per in. in width, and would indicate that this brick when laid in a street pavement on a sand cushion could carry about 20,000 lbs. concentrated at the center of its upper surface without breaking. This is about what the best paving brick is able to do.

Crushing Test.

In the crushing test the load should be applied edgewise on the half-bricks which remain from the cross-breaking test. These half-bricks should be squared up and made approximately symmetrical, and of about equal bearing surfaces, these having an area of from 4 to 6 sq. ins., and a height of about 4 ins. These specimens can then be placed directly between steel bearing plates, provided these are also perfectly true, or a cushioning material can be used, composed of single thicknesses of tar-board. The specimen must be placed in the testing machine with great care, so as to insure an exactly central application of the load. A proof of proper placing in the machine is the failure without previous spalling or cracking off from the sides of the specimen. If the specimen has been properly surfaced, and is properly placed in the machine, failure will come suddenly, with little or no previous warning, and the specimen will fly to pieces as though it had exploded. When for any reason failure occurs gradually, by a continual spalling, the final load is carried by a very much reduced area of cross-section, instead of the entire cross-section, as should always be the case. If all these precautions are taken, it will be found that the best modern paving brick has a strength apparently equal to the strongest granite or marble. The writer has made numerous tests during the past year on paving brick, which sustained a crushing load of from 25,000 to 30,000 lbs. per sq. in. on specimens about 2 ins. square and 4 ins. high.

No crushing test of brick should ever be made flatwise, either on a half-brick or on a whole brick. Any material which fails in crushing like brick or stone should always have a height of specimen about twice the least lateral dimension, in order to give to the specimen an opportunity to fail in a normal or natural manner. Although crushing tests of stone have hitherto nearly always been made on cubical blocks, these are too low to allow of a normal failure, since the angle of rupture of crushing is theoretically about 60° with the horizontal, or 30° from the direction in which the stress is applied. When the cubical form is used, this angle of rupture is reduced to about 45° and hence the specimen gives of necessity an abnormally high result. The extraordinary strength which the writer has succeeded in obtaining from paving brick, however, has always resulted from the employment of specimens having a height about twice their least lateral dimension. When a half or whole brick is tested flatwise, the height of the brick in the direction of the loading is only about one-half of the least lateral dimension, instead of twice that dimension, and hence is only about one-fourth as high as it should be to give a normal failure. Such a test, therefore, gives very deceptive results, and these results are no indication of the real strength of the brick. When brick are laid flatwise in a wall or pier the structure does not fail by the crushing of the individual brick, but it always fails by splitting and failing in detail, so that the crushing strength of a single brick flatwise is no indication of the strength of a wall built of that same brick. Furthermore, the strength of the wall is more dependent upon the character of the mortar used than upon the brick itself. This has been shown to be true by the tests made on brick piers from 12 to 16 ins. square and about 10 ft. high, made on the Emery testing machine at Watertown, Mass.

Abrasion or Impact Test.

While the writer recognizes the difficulty of making this test in a perfectly satisfactory manner, he believes, nevertheless, that it is the most important test that can be made upon paving brick, and that if as many as five or six bricks are employed in making this test, the average loss of weight will give a very true index of the ability of such brick to resist the action of impact loads when laid upon the street. It is the writer's observation that brick pavements do not wear out by actual abrasion on their upper surface, as granite blocks might do, but that they are chipped off on their edges by the quick sharp blows of newly-shod horses, and by the impact action of heavily-loaded vehicles, or by lighter ones moving more rapidly. The quality of brick which will resist this kind of action is, therefore, toughness rather than hardness. Abrasion proper would be resisted by hardness simply, but this chipping action would be resisted by toughness, rather than hardness. A very hard brick might be very brittle, and might readily be chipped and broken when laid upon the street, but in the abrasion test proper would show a very great resistance. A true abrasion test would be a kind of grinding test, as upon a grindstone, but this evidently is not what is wanted for the test of a paving brick. The writer holds that the only way to determine resistance to impact in the case of paving brick is to give it an impact test, and he has ceased to call this test an "abrasion test," and he now calls it an "impact test." The difficulty is to standardize such a test, and make results obtained from different tests truly comparable. If it were possible to give to each brick a certain number of blows of a perfectly definite amount and kind, striking them in exactly the same way, this would be the thing to do; but to undertake to carry this out in practice would result in a very costly and tedious process.

The rattler seems well suited to this test, provided enough specimens of each kind or sample of brick are inserted to give a fair average. While it is true that no two brick placed in a rattler receive exactly the same treatment, it is also true that the average treatment of any five or six brick would differ very little from the average treatment of any other five or six brick placed in the rattler at the same time, or placed in the rattler at a different time, when all the other contents and conditions remain identically the same. The writer is of the opinion, therefore, that the rattler test can be standardized sufficiently in the following manner:

Prescribe a rattler of a given diameter, either made of iron or lined with iron or steel plates. A suitable diameter is 24 ins., and the writer recommends that this be adopted. This rattler should then be run at a specified number of revolutions per minute, for a given time, and the writer recommends 30 revolutions per minute for 30 minutes. The contents of the rattler should always be the same, and the writer recommends five or six brick of the sample to be tested, as many specimens of granite block, weighing each about the same as a single brick, and 10 cast iron bricks with rounded edges, these latter weighing 6 lbs. each. Suitable dimensions for such bricks would be 5 ins. long, 3 ins. wide, and $1\frac{1}{2}$ ins. thick, all the edges being rounded to a radius of about $\frac{3}{8}$ in.

The object of using the granite blocks is to obtain a comparison between the loss of weight of the granite and that of the brick. Although the percentage of loss is obtained for each brick, and for each granite block, the comparison is only made for the average loss of the brick and the average loss of the granite. To standardize this comparison, it would be necessary to use the same kind of granite. Furthermore, these granite blocks should be cut in the same manner, and should have their edges either square or rounded, as the brick has square or rounded edges. Since it will prove to be very difficult to obtain always the same kind of granite, and to have this always prepared in the same way, it is probably advisable to give up this comparison between the granite blocks and the brick and rely on the loss of the brick itself alone. This may be done, if this test is standardized in other respects as here described. In this case the granite blocks would be omitted altogether.

The object of using the cast iron bricks, as above described, is to standardize the impact-producing materials. Evidently the amount of abuse which the brick will suffer from this test depends on the material inserted in the rattler. The standard cast iron bricks as here described can be exactly duplicated, and since the size here named gives about the same weight as that of a brick, 6 lbs., they will have about the same impact effect as the bricks themselves have upon each other. The rounding of the edges will cause these cast iron bricks to remain practically of a constant shape, even after they have become considerably worn.

The writer would recommend, therefore, for a standard impact test the following: Use a steel, or

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steel-lined rattler, 24 ins. in diameter, from 3 to 4 ft. long, run at 30 revolutions per minute for 30 minutes. In this rattler to be placed five or six bricks of each sample, to be tested (not exceeding three sets), and 10 cast iron bricks, these having the following dimensions, 5 ins. long, 3 ins. wide and 1½ ins. thick, all edges rounded to a radius of ⅜ in.

The writer believes, therefore, that the "abrasion test," so called and so used, should be abandoned entirely as a test of paving brick, that in place thereof should be substituted, in name and in fact, an impact test, and that this impact test should be standardized as absolutely as possible, and practically on the lines above described. When this has been done, he believes the results of such tests will prove eminently satisfactory, not only to makers, but to users of paving brick. It is, in fact, a very severe test, and the best of brick will suffer considerably under it; but this test will select with absolute certainty the best brick to be used for paving purposes, provided the other tests are satisfactory. It is to be hoped that the committee now charged with preparing a set of standard tests of paving brick will be able to retain this test, and to prescribe the conditions under which it shall be made in a satisfactory manner.

Absorption Test.

The absorption test has come to be customary and should doubtless be retained. At the same time the writer does not place as much reliance on this test as some people do. He does not believe that any particular percentage of moisture can be named as a limit for paving brick. It is well to determine the percentage of moisture as a kind of collateral evidence of the character of the brick, but he does not see his way clear to use this as a criterion of rejection, even though the moisture absorbed be as much as 3 or 4%. In other words, in determining the best average result of the four tests, he would give little weight to the absorption test. This test, of course, is made by first drying the specimen, and weighing it dry,then soaking it in water for one, two or three days, and weighing again. Inasmuch as it is usually desirable to make this test in as short a time as practicable, the writer recommends that the brick be soaked not longer than 24 hours. While this cannot determine the full capacity for absorption, it would be relatively fair and satisfactory. In drying the brick, some rules or standard should be established. The writer believes that the following would be a satisfactory requirement: Dry the brick in an oven at a temperature not less than 212° F. for a period of five hours. This would enable the drying to be done during the working hours of a single day, and can be done either in an ordinary oven, heated by a gas jet, or the oven of an ordinary stove, or the brick can be laid on top of a stove. It must be understood that no brick is "dry" except it be treated in this manner. That is to say, the moisture of the atmosphere will be absorbed to a certain extent by the brick, and hence to find the "dry weight" it is necessary to first drive off this atmospheric moisture.

The writer prefers to use for the moisture test the brick which have first been tested for impact. His practice has been to take the brick which have gone through the rattler, break them in two, and then dry them in an oven and weigh them as above described. Then place them in water for 24 hours, wipe them off with a towel, and weigh them again. The increase in weight divided by the dry weight gives the percentage of water absorbed. The bricks which have gone through the tumbler are in a particularly favorable condition for the moisture test, since their outer skin is largely removed. This is especially desirable where the bricks have a vitreous or glazed surface.

Determination of Best Average Test.

After having made the four tests as above described, it will often be found that one sample is better in one particular and another sample in another particular, and it becomes difficult to select what may properly be denominated the sample which gave the best test. The engineer who is called upon to decide this question will relieve himself of great embarrassment in such a case if he will prescribe in advance the weight which is to be given to each test, and explain how the average shall be determined. The writer has studied this question carefully, and offers the following rules for determining this average:

The average result of the four tests made on each sample will be indicated by the sum of four characteristic numbers, corresponding to their respective tests, these four characteristic numbers being derived as follows:

1. The characteristic number for the cross-breaking test shall be the cross-breaking strength in pounds per inch in width divided by 1,000.

2. The characteristic number for the crushing test shall be the crushing strength in pounds per square inch divided by 4,000.

3. The characteristic number for the impact test shall be 25 minus the percentage of loss of weight sustained in this test.

4. The characteristic number for the absorption test shall be 3 minus the percentage of absorption.

In case the characteristic numbers found for the impact and absorption tests prove to be negative, they are to be subtracted from the sum of the other characteristic numbers, or added to them, negatively. In other words, the algebraic sum of these four characteristic numbers shall form the basis for determining which brick has sustained the best test.

Thus, if the average cross-breaking strength were 3,500 lbs. per in. in width, its characteristic number would be 3.50. If the average crushing strength were 15,000 lbs. per sq. in. its characteristic number would be 3.75. If the average loss in weight in the impact test was 18.25%, the characteristic number of this test would be 6.75. If the average percentage of absorption was 1.50, the characteristic number for this test would be 1.50, the sum of these characteristic numbers being 15.50. This becomes the total characteristic number, indicating the average value of this sample of brick. The sample giving the highest total characteristic number as determined by the above rules would be declared the brick which sustained the best test.

While the particular numerical quantities chosen in the rules given above may not be the best to use, the writer believes these rules fairly represent the proper method to be employed in arriving at the best average test.

TABLE I.—Results of Paving Brick Tests Made at Pennsylvania R. R. Co.'s Shops by Harvey Linton, City Engineer, Altoona, Pa.

Name and address of maker.	Size, inches.	Modulus of rupture.	Absorption, p.c.	Specific gravity.
Johnsonburg Iron Rock Paver, Johnsonburg, Pa.	2.6 × 4.2 × 8.8	1,462	1.26	2.24
" " " " " " "	2.6 × 4.2 × 8.6	1,482	2.10	2.24
Granite Brick Exchange, Canton, O.	2.5 × 4.1 × 8.3	2,655	0.43	2.37
" " " "	2.5 × 4.1 × 8.3	1,970	0.21	2.39
Stratton Bros., Empire, O.	2.4 × 4.0 × 9.0	1,922	5.65	2.05
" " " "	2.4 × 4.0 × 9.0	1,875	4.71	2.12
American Fire Clay Co., Toronto, O.	2.4 × 4.0 × 8.2	2,740	2.56	2.23
" " " " "	2.5 × 4.0 × 8.2	2,070	3.50	2.22
" " " " "	2.4 × 4.2 × 8.2	1,813	4.35	2.23
" " " " "	2.4 × 4.2 × 8.3	2,721	3.84	2.21
Park Fire Clay Co., Park Quarries, Pa.	2.5 × 4.0 × 8.3	1,595	3.98	2.10
" " " " " "	2.5 × 4.0 × 8.3	1,977	2.63	2.16
McMahon, Porter & Co., New Cumberland, W. Va.	2.5 × 4.2 × 8.7	2,208	2.63	2.09
Savage Fire Brick Co.	2.5 × 4.2 × 8.7	2,041	5.78	2.10
Kountz Bros., Harmersville, Pa.	2.6 × 4.1 × 8.4	2,158	2.82	2.26
" " "	2.5 × 4.1 × 8.5	2,000	3.67	2.31
Mill Hall Brick Works, Lock Haven, Pa.	2.3 × 3.6 × 8.0	2,944	5.07	2.23
" " " " " "	2.4 × 3.8 × 8.0	2,376	0.25	2.54
" " " " " "	2.4 × 3.9 × 8.0	2,120	1.11	2.36
" " " " " "	2.4 × 3.9 × 8.0	2,071	0.98	2.41
Canton Brick Co., Canton, O.	2.4 × 4.2 × 8.5	2,542	2.64	2.34
" " " "	2.6 × 4.2 × 8.4	2,244	1.27	2.37
Hallwood Block, Columbus, O.	3.15 × 4.0 × 9.0	2,548	0.89	2.35
Granite Paving Brick, Malvern, O.	3.15 × 4.0 × 10.0	1,366	1.56	2.15
Holloway Co., Canton, O.	2.4 × 4.25 × 8.4	2,284	0.85	2.40
" " "	2.4 × 4.25 × 8.4	2,221	2.65	2.35
" " "	2.5 × 4.0 × 8.25	2,283	0.71	2.38

TABLE II.—Results of Paving Brick Tests Made at Cornell University Testing Laboratory by James W. Reed, Ithaca, N. Y.

Name and address of maker.	Size, inches.	Specific gravity.	Crushing strength, lbs.	Modulus, Transverse strength, lbs.	Absorption, per cent.	Abrasion, times, trap rock.
Shale Brick Exchange, Canton, O.	2½ × 4 × 8½	2.28	8,905	2,755	1.67	10.47
" " " "	2½ × 4 × 8½	2.24	7,390	2,695	3.02	3.31
" " " "	2.6 × 4 × 8.3	2.27	10,740	2,685	0.58	4.35
Wabash Clay Co., Veedersburg, Ind.	2.4 × 4 × 8½	2.14	6,825	2,555	3.17	6.57
Clearfield Fire Brick Co., Clearfield, Pa.	2.6 × 4 × 9	2.28	9,400	2,365	0.86	10.84
McMahon, Porter & Co., New Cumberland, W. Va.	2.6 × 4.2 × 9	1.95	7,410	1,805	5.25	8.73
Mack Mfg. Co.,	2½ × 4 × 8.2	2.11	8,585	1,605	1.69	17.18
" " " " " "	2.3 × 4.3 × 8	2.09	4,985	1,450	5.25	13.18
" " " " " "	2.4 × 4.2 × 8	2.12	8,095	2,010	3.74	14.33
Keystone Brick Co., Keystone, Pa.	2.6 × 4 × 8½	2.12	9,555	1,710	1.69	15.87
——————, Junction Pa.	2.4 × 4.2 × 8½	2.19	5,425	2,100	1.79	9.31
Stratton Bros., Empire, O.	2.3 × 4 × 8½	2.09	5,165	1,585	5.09	9.44
Franklin Shale Paving Brick Co., Franklin, Pa.	2½ × 4.1 × 8½	2.27	13,160	2,675	2.33	7.13
Park Fire Clay Co., Park Quarries, Pa.	2.4 × 4 × 8.4	2.00	12,245	1,790	3.99	13.77
" " " "	2½ × 3.9 × 8.3	1.98	6,555	2,005	3.45	8.46
Kountz Bros., Harmarsville, Pa.	2.6 × 4.1 × 8.4	2.16	9,575	2,360	2.61	11.18
Campbell & Wood, Newfield, N. Y.	2 × 3.8 × 8	2.18	11,440	3,175	3.99	7.19
" " " "	2.4 × 3.8 × 8.3	2.28	12,340	3,070	1.11	4.43
" " " "	2.4 × 3.8 × 8.3	2.23	13,750	5,005	1.52	0.87
Purington Brick Co., Galesburg, Ill.	2.3 × 3.8 × 8	2.13	8,640	2,740	3.82	7.45
" " " "	2.3 × 3.9 × 8	2.17	3,405	1,930	0.99	13.59
Jamestown Shale Paving Brick Co., Jamestown, N. Y.	2½ × 4.2 × 8½	2.22	8,215	2,235	2.48	7.21
Monongahela Fire Clay Co., Monaca, Pa.	2.6 × 4 × 8½	2.22	14,650	3,170	0.28	1.06
John C. Bolen, S. Zanesville, O.	3 × 4 × 8.8	2.13	7,085	3,425	1.58	7.53
Nelsonville Sewer Pipe Co., Nelsonville, O.	3 × 4 × 9	2.18	4,125	2,155	0.79	6.61
Athens Brick Co., Athens, O.	3 × 4 × 9.2	2.14	8,210	3,375	2.46	12.14
Trap rock	.....	2.93	.....	.....	0.52	1.00

RECENT PAVING BRICK TESTS.

We give in the accompanying tables the results of three different series of tests made to determine the physical qualities of the different makes of paving brick in common use. These tests, as will be noticed, include paving bricks from very widely separated parts of the country, covering practically all of the large centers of paving brick manufacture, and are also of interest as showing the results obtained from the same makes of bricks by different persons. We have discussed briefly some of the points brought out by these tables in our editorial columns, but otherwise the figures need but little explanation, aside from that given in the tables themselves.

The results given in Table I. were obtained from a series of tests made at Altoona, Pa., by Mr. Harvey Linton, City Engineer, and comprise bricks from 13 different manufacturers, all, with one exception, located in the states of Pennsylvania and Ohio. The transverse tests were made with a Riehle testing machine, and the modulus of rupture was calculated by the formula

$$\frac{3\ W\ L}{2\ B.D^2}$$

with W = weight applied; L = the span in inches (6 ins.); B = the thickness, and D = the width. In the absorption tests the brick were heated to 116° F. for 12 hours and then placed in water at 60° F. for 48 hours. From the differences in weight before and after immersion the percentages of absorption were calculated. The specific gravity was determined by the formula

$$\frac{W}{W' - W''}$$

in which W = weight of brick dry; W' = weight of brick after 48 hours of immersion, and W'' = weight of brick in water.

The figures in Table II. were obtained from

TABLE III.—Results of Tests of 2 × 4 × 8-in. Paving Brick, at Peoria, Ill.

Manufacturer.	Abrasion, per cent.	Absorption, per cent.	Modulus of rupture, lbs.
Spurck Paving Brick Co.	7.65	2.90	1,989
" " " "	7.99	....	.....
St. Louis Pressed Brick Co.	10.92	1.08	2,616
Springfield Paving Brick Co.	12.59	1.07	2,593
Spurck Paving Brick Co.	6.12	3.20	1,722
" " " "	....	7.47	1,543
Grape Creek Clay Works.	11.16	1.68	1,908
Galesburg Brick & Terra Cotta Co.	6.59	3.14	2,818
Wabash Clay Co.	9.28	2.23	1,949
Leaman Clay Co.	11.19	1.01	981
Ottawa Fire Clay & Brick Co.	7.06	2.95	.....
Streator	7.66	5.50	.....
Ohio	....	2.53	2,129
Central City Brick & Tile Co.	8.05	4.19	2,184
Pioneer Paving Brick Co.	....	5.59	1,743
Wabash Clay Co	7.65	1.69	2,279
Ottawa Paving Brick Co	17.10	4.15	.....
Uhrichsville Fire Clay Co.	15.35	4.96	1,278
Abingdon Brick & Tile Co.	11.44	3.70	.....
St. Louis Pressed Brick Co.	9.79	0.27	3,157
Springfield Paving Brick Co.	9.40	1.70	3,018
" " " "	9.45	2.14	3,496
Purington Paving Brick Co.	5.70	2.39	2,893
arck Paving Brick Co.	6.08	3.46	1,427
Purington Paving Brick Co.	4.76	0.90	2,667
" " " "	5.91	0.54	3,072
" " " "	8.03	1.37	3,153
" " " "	7.06	1.93	3,237
Spurck Paving Brick Co.	8.20	1.60	2,188
Purington Paving Brick Co.	5.61	1.70	2,580
" " " "	8.17	1.52	3,342
" " " "	9.70	0.39	2,667
" " " "	7.09	1.52	2,508
Spurck Paving Brick Co.	9.54	7.05	1,583
" " " "	7.15	0.90	1,872
Purington Paving Brick Co.	7.67	3.60	2,279
" " " "	6.00	1.30	2,681
St. Louis Pressed Brick Co.	9.92	0.13	2,917
" " " "	6.20	0.47	2,797
" " " "	5.53	0.83	2,608
" " " "	8.22	2.31	2,214
Spurck Paving Brick Co.	6.60	3.84	1,883
" " " "	5.70	1.65	2,263
St. Louis Pressed Brick Co.	....	0.43	3,059
" " " "	7.07	0.57	.....
" " " "	....	0.78	2,852
" " " "	2.81	1.10	.. ..
" " " "	....	0.82	2,137
Purington Paving Brick Co.	7.23	1.92	.....

tests made by Mr. Jas. W. Reed, Civil Engineer, of Ithaca, N. Y., and cover 18 different makes of brick from factories in New York, Pennsylvania, Ohio, West Virginia, Indiana and Illinois. An interesting feature of this table is the figures showing the comparative resistance to abrasion of paving brick and trap rock, which is used for stone block paving in a number of our Eastern cities.

Tables III. and IV. are compiled from tables given in the Report of the Department of Public Works of Peoria, Ill., for 1894, and give the results of tests of cargoes of bricks shipped for paving work in that city. The transverse tests were made with a Riehle 100,000-lb. screw testing machine, belonging to the city's testing laboratory, and the broken brick were then tested for absorption after being thoroughly dried in a gas oven. In some cases the abraded brick taken from the rattler were used for absorption tests. The tests for abrasion were made in a foundry rattler 2 ft. in diameter and 4 ft. long, and consisted in placing the bricks in the rattler with 300 lbs. of scrap iron, consisting of smoothly-worn pieces varying from 1 lb. to 5 lbs. in weight. No more than 12 small brick or four large brick were placed in the rattler at one time. The rattler was revolved at the rate of 15 revolutions per minute for one hour. It is stated in the report that an attempt was made to compare the loss by abrasion of small bricks with the loss of Quincy granite, but that it proved unsatisfactory. In conclusion, the report says:

Freezing tests are now being conducted upon paving bricks, but they have not reached the point where results can be given. Samples of paving bricks of varying degrees of absorption, made from two different shales, were obtained from two manufacturers. The per cent. of absorption of each was obtained, the samples thoroughly dried in a gas oven, weighed, immersed in water for 48 hours, and then frozen in a vat of water, being subjected to a temperature of 17° F. After being thoroughly frozen, the samples were thawed, dried, weighed and the loss of weight noted. This process has been repeated eight times, and will be continued until some of the samples which absorb most water are entirely disintegrated. Thus far the disintegrating effect is hardly perceptible, except on the softest samples.

For the benefit of those of our readers who may wish to look up the records of similar tests, we give the following references to former issues of this journal: University of Wisconsin, June 21, 1890; Omaha, Neb., June 28, 1890; various places, July 26, 1890; Kansas City, Mo., April 11, 1890; Providence, R. I., Sept. 26, 1891; Boston, Mass., June 2, 1892; Easton, Pa., March 30, 1893; Fostoria, O., Sept. 21, 1893; St. Louis, Mo., July 26, 1894; Steubenville, O., Dec. 13, 1894.

TABLE IV.—Results of Tests of 4 × 5 × 12-in. Paving Blocks at Peoria, Ill.

	No. tested.	Absorption, p. c., in 48 hours.	No. tested.	Abrasion, p. c., one hour.	No. tested.	Modulus of rupture.
Spurk Paving Brick Co.	54	2.44	13	4.39	53	1,194
" " " "	8	2.03	4	5.93	5	1,228
" " " "	9	2.37	6	5.89	4	905
" " " "	15	2.64	2	5.23	8	1,277
" " " "	6	1.50	3	5.26	6	1,584
" " " "	9	3.75	3	5.90	6	1,195
" " " "	9	3.70	3	5.80	6	1,275
" " " "	10	4.60	4	5.90	6	1,462
" " " "	7	3.34	3	5.10	7	1,288
" " " "	8	2.67	2	6.02	8	1,509
Peoria Paving Brick Co.	10	1.73	5	9.20	..	.....
" " " "	6	0.90	8	6.92	13	1,587
Grape Creek Clay Works.	12	5.43	5	12.32	6	1,232
" " " "	6	3.51	3	3.57	3	2,081
Ottawa Paving Brick Co.	2	2.20	2	4.30	3	1,272
" " " "	7	3.63	7	6.70	7	996
Ottawa Fire Clay & B'k Co.	2	2.55	1	11.77	1	1,367

VERTICAL LIFT LOCK FOR THE ERIE CANAL AT LOCKPORT, N. Y.

For some years past work has been in progress on the improvement of the Erie Canal, the principal improvements being to give the full depth of 7 ft. (which will probably be increased later to 9 ft.), and to double the length of the locks. The object of this latter improvement is to facilitate the time of passage of the locks, as very little of the traffic is now carried by single boats. The enlarged locks are about 221 ft. long, and 18 to 20 ft. wide. There are 72 locks on the 363 miles of the canal, and 40 of these have been lengthened, but the remaining 32 are more difficult to deal with, most of them being bunched in groups or "flights." At Lockport, N. Y., the canal makes a change of level of 54.427 ft. by means of five successive locks, and as the conditions are such as would involve very heavy expenditures for the lengthening of the locks in accordance with the improvements being carried out along the canal, it is proposed to construct a vertical hydraulic balance lift lock. This work is described by Mr. Campbell W. Adams, State Engineer and Surveyor, in an article in the "Canal Defender," and we are indebted to Mr. Herschel Roberts, Deputy State Engineer and Surveyor, for blueprints and other information. Mr. Roberts states that the plans are not yet perfected, as there are no available funds for their completion, so that they have simply progressed far enough to form the basis of reliable estimates, and for the preparation of a perspective view, reproduced herewith. The Assembly has passed a bill appropriating $100,000 for this work, and if this becomes a law it is hoped to build one lift (or half the proposed lock) to demonstrate the feasibility of the project. When that is done, it is expected that a similar plan for replacing the 16 locks at Cohoes, N. Y., with one lock of 140 ft. lift will surely be adopted. The lifting lock at Lockport will be the largest ever built, each trough carrying 75% more water than those of any of the existing hydraulic locks, referred to in another column, and being operated in an entirely different way from any of its modern predecessors.

The plan, as described by Mr. Adams, provides for two steel troughs or lifting chambers, placed side by side, and each having a capacity of 1,150 tons of water. These troughs are to be heavily built and braced, and the bottom of each will be supported by floor beams 5 ft. apart, the ends of which beams will project beyond the sides of the trough, and form the points of attachment for the lifting chains. On each side of each of the two lock chambers at the lower level of the canal are to be erected rows of columns, with lateral and overhead bracing, forming a steel framework extending above the upper level of the canal. On top of this framework will be four longitudinal lines of shafting directly over the edges of the troughs, and these will carry sheaves or sprocket

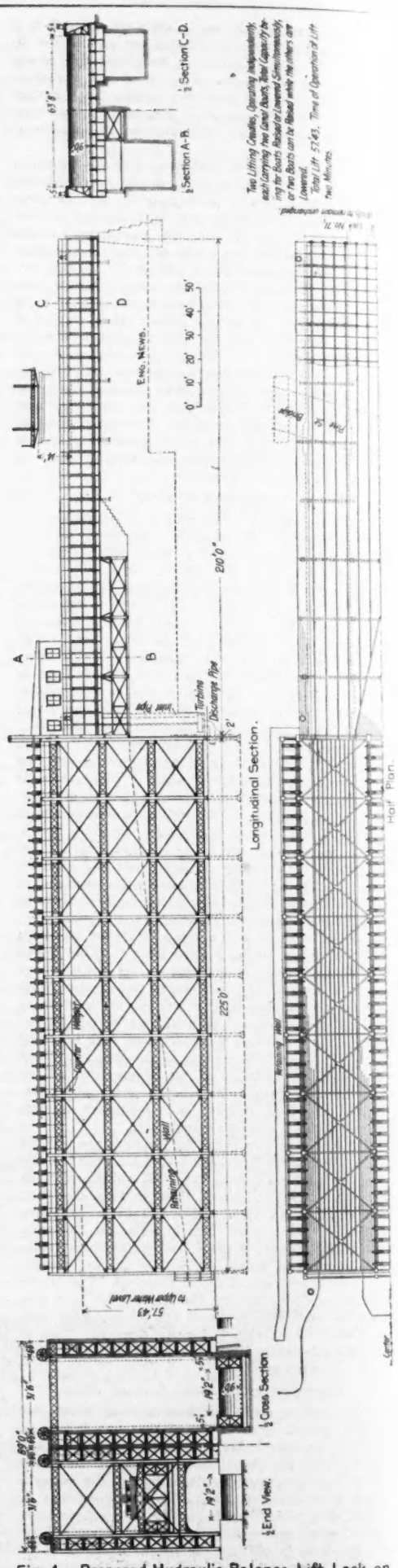
Section C-D.
Section A-B.
Two Lifting Cradles, Operating Independently, each Carrying Two Canal Boats, Total Capacity being Two Boats Passed or Lowered Simultaneously, or Two Boats can be Raised while the others are Lowered.
Total Lift 57'43". Time of Operation of Lift Two Minutes.
ENG. NEWS.
Turbine
Discharge Pipe
Longitudinal Section.
½ Cross Section
½ End View.
Half Plan.

Fig 1. Proposed Hydraulic Balance Lift Lock on the Erie Canal, at Lockport, N. Y.

wheels for the chains attached to the floor beams, the free ends of the chains being attached to counterweights, which slide on guides in the framing. At the lower position each trough rests in a dry lock chamber, from which any water entering by leakage will be removed by pumping or by drainage. The ends of the trough will be closed by vertically sliding gates, which will be attached to similar gates at the upper and lower approaches, so that the two gates will be opened and closed together, these operations being performed by hydraulic, pneumatic or electric power. The gates will carry footbridges. The joint between the movable trough and the fixed approach will be effected by a metallic wedge fitted with rubber packing, the wedge fitting along the bottom and both sides of the trough, and the ends of the troughs and approaches being beveled, so as to fit the wedges. Each wedge is adjustable for any varying width of opening, and is to be operated by power, being forced home or released by a single motion. Electric motors will be attached to the four overhead shafts, by means of which the motion of each trough can be accelerated, retarded or stopped at will, the advantage of electric motors for this purpose being that the power can be simultaneously applied at a great number of points, thus giving a good and even distribution of the power, which would not be attained by any system of transmission through gearing and shafting.

The trough will be 225 ft. long, and 29 ft. 2 ins. wide over all, with a waterway 19 ft. 2 ins. wide in the clear, each trough carrying two canal boats of 250 tons capacity, weighing about 350 tons each. The clear depth of water will be 9 ft. The framework will have two rows of columns on each side of each chamber, the rows being 6 ft. 6 ins. apart, and the columns spaced 25 ft. c. to c. longitudinally. There are four lines of horizontal lattice trusses, with diagonal bracing between the bents and rows of columns, and overhead diagonal bracing. The distance c. to c. of shafts will be 31 ft. 6 ins., and the total width over the framework 89 ft. The counterweights will be shallow troughs filled with pig iron and sliding between the rows of columns. The steel approach, or aqueduct, at the upper level, will be 210 ft. long from the existing masonry to the lift lock. It will be 63 ft. 8 ins. wide in the clear, with a 5-ft. walk or towpath on each side, and a clear depth of 9 ft. of water.

At the upper end of the lock and between the two troughs it is proposed to place a turbine, taking water from the upper level and discharging it into the lower level. This turbine will have sufficient capacity to operate all the plant, including capstans for hauling the boats in and out of the locks, air compressors for operating the gates and wedges, and a dynamo for electric lighting and power. The compressor, dynamo and other machinery will be contained in the operator's house, built over the turbine. In the operator's room will be all the levers for controlling the various movements, with indicators showing the exact height of water in the upper and lower levels, and showing also the exact position of each trough.

The new locks are intended to be placed at the lower end of the present series of locks, occupying the space of locks No. 67 and No. 68. A steel aqueduct will extend the upper level of the canal over locks No. 69 and 70, while lock No. 71 will not be altered, but will be used as a guard lock. The aqueduct will be supported by the masonry of the old locks, but the masonry of the two lower locks will be altered to form the dry chambers.

The operation of the lifting troughs will be effected by a surplus or deficiency of water in the trough, so as to exceed or be exceeded by the weight of the counterbalances, according as to whether the trough is to be lowered or raised. It is estimated that a surplus of 3 ins. in depth of water in the trough will be sufficient to overcome the friction of the machinery, and cause the trough to run down. An eastbound boat approaching on the upper level will be drawn by its team into the guard lock, from which it will be hauled into the trough by means of hydraulic capstans. The vertical gates will then be lowered to close the end of the trough and the end of the approach, and the water in the space between the gates drained off, the inner pressure of the water in the trough and canal then forcing the respective gates tightly against the seats. The horseshoe wedge between the trough and the canal will then be dropped slightly, leaving the trough free to descend as soon as the brakes are removed. The motion is to be slow, and at the bottom and top it will be gradually retarded by the brakes and by hydraulic or pneumatic buffers. At the bottom the trough will be stopped with its water level 6 ins. above the water level of the canal, the wedge joint will be adjusted and valves then opened to allow the water to flow into the space between the gates of the trough and canal, after which the gates will be raised, the boat drawn out by the capstans and taken on by the team. According to Mr. Adams' description the teams will be driven along an inclined roadway from one level to the other, but there seems to be no good reason why they should not go on the troughs with the boats, as on the European canal lifts. When the gates have been opened at the lower level, the surface of the water in the trough is lowered 6 ins., so that the weight will be less than that of the counterweight by 3 ins. of water, and when the brakes are removed the trough will be raised. At the upper level the trough will always be stopped with its water level 3 ins. below that of the water in the canal, and at the lower level it will always be stopped with its water level 6 ins. above the level of the water in the canal. It is estimated that the time for raising or lowering the trough, including the retardation of the brakes, will be about two minutes, and that the total time for transferring a boat from one level to the other will be about fifteen minutes.

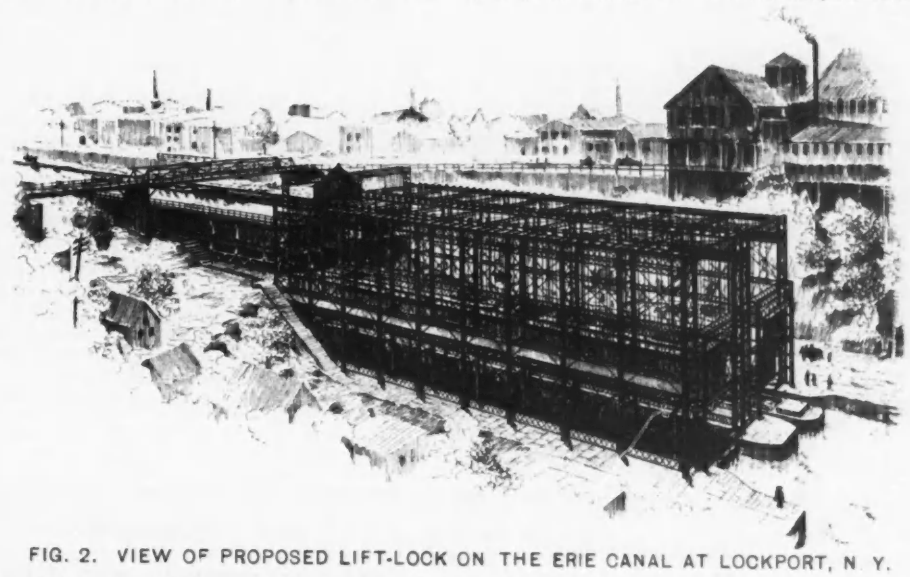

FIG. 2. VIEW OF PROPOSED LIFT-LOCK ON THE ERIE CANAL AT LOCKPORT, N. Y.

The cost of this improvement at Lockport is estimated at $300,000, and the average cost of lengthening 40 of the 72 locks on the Erie Canal has been $30,700 (the range being from $23,000 to $40,000). The proposed first construction of half the lifting lock (with one instead of two troughs) could therefore be effected for less than the cost of lengthening five locks, while at the same time four locks will be dispensed with. Even if it were practical to lengthen the present locks, the cost of operation would be as great as, if not greater than, at present, while under the proposed plan a saving of $5,000 per year in operating expenses can be effected. The completed system on the new plan would require the continuous services of only four men: an engineman or superintendent in the operator's house, one man on each lift to operate the gates and wedges, and one oiler or general assistant. The work could be done in five months, which is the limit of time available for remodeling these locks without interrupting traffic. As already noted, 40 of the locks on the Erie Canal have been lengthened, but it is said that the other 32 locks are so located that the work would be very expensive, and in some cases impracticable, and the system above described seems to be specially adapted for superseding long flights of locks, such as the five locks at Lockport and the 16 locks at Cohoes.

THE DETROIT GRAPHITE PAINT.

A great deal of attention is being paid by engineers of late to the character of the paints used in engineering construction, and especially to those used for protecting structural ironwork. In view of the enormous amount of iron now being used in fireproof buildings, where it is never accessible for inspection or repainting, it is, indeed, of the greatest importance that the iron, when erected, shall be furnished with a coating that will give thorough protection against corrosion, and in whose durability the engineer can feel entire confidence.

Much more attention is now being paid than formerly to the chemistry of paints and painting. In most of the paints in common use there is a chemical action between the pigment and the oil with which it is mixed. In white lead, for example, the oil forms with the lead an insoluble lead soap. In red lead it is claimed that the pigment acts as an oxidizing agent and forms a thin coating of oxide upon the metal beneath it, which protects it from further corrosion. Oxide of iron paint, which was so long the favorite cheap paint, and which gives excellent results on wood, has been claimed in recent years to have a marked oxidizing effect on iron painted with it.

There is a class of paints, however, in which no chemical action whatever takes place between the oil and the powder with which it is mixed, and of this class graphite is doubtless the most important. The abundance and cheapness of graphite enable such paints to be made at a low price. Its lightness and the fineness and smoothness of its particles cause the powder to mix with the oil very readily, and to apply evenly, the pigment not settling to the bottom of the pail, as is the case with paints made up from a heavy pigment. The drying action of such a paint is unlike that of a lead paint. It may well be likened to a mortar, the graphite particles corresponding to the sand and the oil to the cement. When the two are mixed together, the graphite simply thickens the oil, so that it becomes of the proper consistency to cover the surface to the desired thickness. As the paint dries the linseed oil forms a rubber-like gum, cementing and binding the particles of the graphite firmly together. This gummy coating is claimed to be much less porous than the coating formed by the drying of the lead soap, in a lead paint, and it is thus more impervious to water and better protects the surface beneath it. Finally, as no acids or alkalies are used in the manufacture of the paint, there is no opportunity for corrosion to be caused by acid or alkali remaining in the paint, as often happens with lead paint.

A brand of graphite paint made by the Detroit Graphite Mfg. Co., of Detroit, Mich., and designated as "Superior" graphite paint, has attracted considerable attention from engineers of late, through its adoption for some important structures and some novel applications which have been made of it. The company procures its graphite from extensive mines owned by the company in Northern

Michigan, which are said to produce a graphite of remarkable fineness and smoothness. It is manufactured at the company's works at Detroit, and is put up, ground in oil, in pails or barrels, the price in quantity being $1.10 per gallon. One gallon covers 600 to 800 sq.ft., however, which the manufacturers say is two to four times the covering power of a similar bulk of lead or oxide of iron paint.

Concerning the resistance of the paints to the corrosive action of acids or alkalies, the makers inform us that they have subjected it to the following severe tests:

Pieces of iron painted with our paint, which are now being tested, have been dipped in muriatic, sulphuric and oxalic acids, and then allowed to dry with the acid on them for 19 days, at present writing, without showing a particle of damage to the paint. The longest time which other paints withstood these conditions without injury was 24 hours, when they were entirely destroyed. Our graphite paint has also been immersed in ammonia and sal soda for 19 days, in coal oil for several weeks, and in strong brine for six years, without showing injury. We have also submitted pieces of iron painted with graphite paint to 24-hour tests in boiling alcohol, boiling beer, boiling brine and boiling sugar and water without the paint showing any injury. Red lead paint subjected to boiling alcohol stood 15 minutes; to boiling beer, 30 minutes; to boiling brine, 25 minutes; to boiling sugar and water, 15 minutes. Our graphite paint has also stood in cold soft soap 24 hours without damage, while other paints stood for one hour only. These are extremely hard conditions, and, except possibly some of the simpler ones, it is seldom that a paint is ever subjected to them.

Concerning the resistance of the paint to intense heat, the makers inform us that steel chimneys painted with it have become heated to a red heat without blistering the paint. Some crude tests made at this office have shown that thin pieces of sheet iron painted with "Superior" graphite paint can be held over the flame of a gas jet for several minutes without the paint being blistered. Similar tests with red lead paint showed that the paint would blister and scale off when subjected to the flame of an ordinary parlor match. In both of these tests the side of the iron opposite the paint was held against the flame. In the same manner a piece of canvas painted on both sides with graphite paint withstood the flame of a gas jet several minutes without being burned; in fact, when the canvass was cut through after the test, the fibers were not discolored by the heat. As indicating the elasticity of the paint, it may be stated that a piece of ordinary sheet tin painted with it was twisted and bent in all directions without scaling or cracking the paint.

The waterproof and elastic qualities of the paint have been illustrated by its makers by painting a two-bushel grain sack with it, and then filling it with water. We are informed that the sack held the water without the leakage of a drop, and that it has hung in the company's office for nearly three years without loss of the water, except by evaporation, and the bag is still elastic and flexible. Another and still more interesting application of the paint was made to the tubes of a steam boiler, the paint being applied to the water side. It is stated that this application has had the effect of preventing the formation of scale upon the tubes, and that the graphite is now as smooth and firmly adherent as when first applied, although the boiler has been in use about two years since the application. Mr. Robert Miller, Gen. Supt. of the Michigan Central R. R., informs us that the paint has been used with much success on the steel hulls and decks of the company's transfer steamers at Detroit, and that the test there shows it to be much superior to any mineral or other paint which the company has tried.

A frequent objection to graphite paint is its color, but the manufacturers of this paint furnish it not only in its natural color, but in any shade, from the natural color to dark green, slate, brown or black. This graphite paint has been used on the ironwork of the Metropolitan Life Building in New York city, the Chamber of Commerce and Masonic Temple, at Detroit, Mich., and is being used by the Carnegie Steel Co., the Standard Oil Co., the Detroit Bridge & Iron Works, the Grand Trunk, Canadian Pacific, Michigan Central and other railways.

THE NEW WATER-WORKS SYSTEM OF OTTAWA, ILL.

The first attempt at a public water supply of any sort for the city of Ottawa, Ill., was made by Hon. John D. Caton, who, in 1860, constructed a small reservoir, and piped water by gravity to a number of manufacturing and business establishments. For household and general uses, water has been secured from surface and artesian wells, and in 1894 there were in use 168 artesian wells, all owned by private individuals and corporations. In the spring of 1893, steps were taken to secure a water supply more nearly adequate to the needs of the city, which had grown to have a population of nearly 14,000.

The city found itself at the beginning in a quandary as to how the necessary money for such a system as was wanted could be secured. It was estimated that water-works would cost at the least $160,000, and, moreover, it was insisted by the people that the works should be owned by the city, which could be bonded only to the amount of $60,000. To get around this limitation, a novel method was adopted. In May, 1894, an ordinance was passed by the City Council granting Gregory-Reed Co., of Chicago, Ill., under the name of the Ottawa Water Co., of Chicago, a franchise to build a water-works system. This franchise provided that the city, upon the completion of a system of works, valued at $160,000, should pay the company $60,000 in advance for hydrant rentals, issuing bonds to that amount, and at any time after the acceptance of the works and the payment of this money, should have the power, on giving proper notice, to take possession of the plant and place it in the hands of a trustee by agreeing to pay the balance of the cost of the works—viz., $100,000—in bonds to be issued by the company, together with the interest on those bonds, in annual payments extending over a period of 20 years, in lieu of paying hydrant rental. In plain words, what the city actually does, is to pay $60,000 down and $174,370 in annual installments of about $8,700 each; or, to put it another way, the city bonds itself for $60,000 and assumes the bonded indebtedness of the dummy company, amounting to $100,000 at 6% interest. Legally, however, the city simply pays $234,370 in hydrant rentals for 20 years, at the end of which period the works revert to it by stipulations of the franchise.

This plan of securing money, of course, first necessitated a contractor being found who would agree to assume the role of the dummy company, and would wait for his pay until the works were finished, and also one who could market advantageously the $100,000 in bonds issued by the company. Only two propositions were received in answer to the city's advertisement, and the system proposed by Gregory-Reed Co., of Chicago, being considered the most suitable, the contract was let to that firm.

Briefly described, this system consisted in sinking six 6-in. artesian wells, from 380 ft. to 395 ft. deep, the flow from which was to be stored in a covered brick reservoir, and pumping from this reservoir to a stand-pipe, and also direct into the mains for fire pressure.

The artesian wells are sunk to the bottom of the St. Peter sandstone, from which nearly all the artesian water of this section of Illinois is obtained, and are 7 ins. in diameter, and are lined with a 6-in. wrought iron tube for a depth of 285 ft., or roughly, to within about 100 ft. of the bottom. The flow of each well, of which there are six, spaced about 150 ft. apart, is 50 gallons per minute, and the water enters the reservoir about 3 ft. below the surface. This reservoir is 50 × 100 ft. by 13 ft. deep, and has brick side walls and a concrete bottom. The reservoir is covered with a wooden roof, and from it the water is drawn direct to the pumps through an 18-in. pipe.

The pumps are two Worthington compound condensing pumps, having 14-in. and 24½-in. steam cylinders, and 14-in. double-acting plungers, all with an 18-in. stroke. Each engine has a direct steam connection with the low-pressure cylinder, so that it can be operated as a high-pressure fire pump. From the pumps to the stand-pipe there is a line of 16-in., 14-in. and 12-in. pipe two miles long. The stand-pipe is 20 ft. in diameter and 100 ft. high, and is constructed of open-hearth steel having a tensile strength of 55,000 lbs. The thickness of the steel varies from 9-16 in. to ¼ in. The elevation of the bottom of the stand-pipe above the business portion of the city is 98 ft., and when full it gives a pressure of 85 lbs. per sq. in. in this section of the city. For fire protection purposes there is also a direct connection between the pumps and the Fox River, so that in case the well supply proves inadequate, the water of the river can be drawn upon.

FIG. 1. PROFILE OF SUBMERGED PIPE LINE CROSSING ILLINOIS RIVER, OTTAWA, ILL., WATER-WORKS.

The total length of water mains in 24.55 miles, made up as follows:

Size, ins.	Length, miles.	Size, ins.	Length, miles.
4	1.61	12	1.25
6	15.5	14	1.07
8	3.71	16	0.9
10	0.51	..	....
Total			24.55

The only portion of the pipelaying which calls for especial mention is the 550 ft. of 14-in. pipe under the waters of the Illinois River. A profile of this submerged pipe is shown in Fig. 1. The depth of the water where the pipe crosses the river varies from 3 to 12 ft. From the south, or right hand in the illustration, 260 ft. of the pipe was laid in a trench excavated in sandstone rock; then came 170 ft. of coarse gravel and then solid rock again. The larger deflections were made with ball joints and the smaller by means of wedge-shaped gaskets of pine. The ball-joints used are of a rather novel type, and are shown in elevation and section in Fig. 2. In the shallow water, on the south side of the river, a trestle was built along the route the pipe was to occupy, and from this trestle the trench was drilled and blasted. This trench was from 16 ins. to 24 ins. deep. Long-handled scrapers or hoes were used to clean the trench ready for the pipe. The pipe was connected up on the trestle and then lowered into place by means of derricks. A single section 175 ft. in length was laid in this manner. In the deeper water the work was done from a 20 × 45-ft. barge, the process of excavating being the same as when the trestle was used. Each joint was lowered separately and bolted together by the diver after being placed. The total cost of the system, according to the contractors' statements, was $157,628.

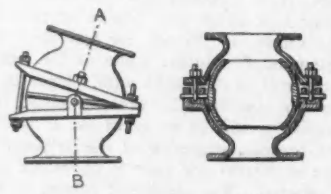

Fig. 2. Ball Joint for Submerged Pipe Line, Ottawa Water Works

The works were formally tested Feb. 28, and proved satisfactory in all respects. The construction was carried out under the direction of Mr. N. E. Stucker, City Engineer of Ottawa, to whom we are indebted for the matter from which our illustration and this description have been prepared.

PRESERVATION OF IRON STRUCTURES EXPOSED TO WEATHER.

By E. Gerber, M. Am. Soc. C. E.

Some fears having arisen that iron oxide applied to certain large structures was causing the metal under the paint to rust, from the fact that rust was found under the paint where there was no indication of it on the surface, the writer was instructed some time ago to make an examination of a large number of prominent bridges, all painted with this same oxide of iron paint, and to report on the visible condition of the paint and the condition of the metal under the paint.

In the course of this examination the following structures were examined: The bridges at Cairo, Ill.; Memphis, Tenn.; Merchants, at St. Louis, Mo.; Bellefontaine, near St. Louis; Leavenworth, Kan.; Rulo, Neb.; Nebraska City, Plattsmouth, Union Pacific Ry. Bridge, Omaha and Blair, Neb.; Sioux City, Ia., and Alton, Ill., all painted with one kind of pure iron oxide paint, mixed with pure linseed oil.

The draw bridge at Omaha, Neb.; the lower bridge at Winona, Minn.; the union passenger station at St. Louis; the State St., Wells St., Clark St., Adams St., Jackson St., Van Buren St., and Wisconsin Central Ry. bridge at Polk St., in Chicago; all of which were first painted with red lead and subsequently with some other paint, usually oxide of iron.

The wagon bridge at Omaha, the Madison St. bridge and Madison St. viaduct in Chicago, painted with an unknown paint, but having the appearance of being a white lead, tinted.

The Rush St. bridge, Dearborn St. bridge and viaduct, Lake St. bridge and viaduct, Lake St. Elevated Ry. bridge, Jones & Laughlin's bolt shed, Adams St. viaduct, Jackson St. viaduct, Metropolitan Elevated Ry. bridge, Harrison St. bridge and viaduct, Polk St. draw and viaduct, and Taylor St. bridge and viaduct, at Chicago, all of which were first painted with what appeared to be an iron of oxide paint.

Visits were also made to the shops of the Missouri Valley Bridge & Iron Works, and Lassig Bridge & Iron Works.

On all structures examined, whatever paint had been used, rust was found to some extent under the paint. In some cases this was very little, in others much worse, and it was found on all parts of the bridge, whether specially exposed to weather or not. The rust was in spots in most cases, the limits of the spots being often quickly reached. In most bridges the clean metal predominated. It was found in general that a metal which had come from the rolls with a smooth surface was much less likely to have rust under the paint than one which had left the rolls with a rough surface. Plates were as a rule freer from this rust than shapes or angles, though when the latter were smooth they were clean. Eye-bars were usually free from rust, and those portions of members in iron structures which had been heated in process of manufacture showed also less rust than others. The age of the structure did not seem to have any special influence on the rust under the paint, as some of the bridges which had stood longest were much cleaner than others which had been built only a few years.

Of the bridges mentioned in the second paragraph as having been painted with a known oxide of iron, the Blair bridge had been standing the longest, it having been erected in 1883, painted in 1884, and not since. While this bridge showed more rust externally than some of the newer bridges and those which had been repainted, the metal under the paint was remarkably clean. On the other hand, the Bellefontaine bridge, which was erected in 1893, and painted in 1894, had a good deal of rust under the paint.

Some of these bridges had been given a coat of oil in the shop, while others had been painted there, and it was noticeable that the bridges which had been oiled had much cleaner metal under paint than those which had been painted in the shop. At Alton and Bellefontaine, guard angles had been shipped to the bridge without either oil or paint on them. These were thoroughly cleaned in the field before painting, and the iron under the paint on them was perfectly clean when examined.

On a number of the bridges marks were found which were evidently painted on the metal with white lead in the mill; wherever these marks were removed, the metal under them was invariably found clean. Other marks of a similar character, which could be traced, however, definitely to the shop, were often found with rust under them.

The nature of the rust spots, which were observed under the paint, was generally of a thin filmy character of a yellowish color, and apparently not in an active state; at times heavier rust was found, but this was comparatively rare. The rust spots under the paint on old bridges were no worse than under that on the newer ones, which shows pretty conclusively that the rust under the paint is not active.

As for the condition of the paint itself, that on the bridges mentioned in the second paragraph, namely, the pure iron oxide mixed with pure oil, was tough in every case, and adhered very firmly to the metal, the adhesion and toughness improving with the age of the structure, except in one case, where an unusually large quantity of paint had ben applied, and this probably frequently. In this case the full thickness of paint was comparatively soft where not exposed to sun, and where it was in this soft condition it was readily removed.

The paint on the bridges painted with red lead, with the exception of that on the draw bridge at Omaha, was universally brittle and very easily removed. The same was true of the mill and shop marks wherever found. On the Winona bridge, which had been painted with white lead as a finishing coat, the paint was cracking wherever exposed to sun. A few structures painted with carbon paint showed this to be noncohesive and easily removed. The paint on the bridges in Chicago, which were painted with iron oxides, other than the one referred to above, was brittle in some cases, and in others tough; it appeared much better, however, than the red lead paint.

As for durability of paint, none of the bridges painted with red lead had stood more than seven years without repainting, and most of them had stood only two or three. When comparison could be made, however, between bridges of about the same age and same exposure to atmospheric conditions, the comparison seemed to be in favor of the oxide of iron. The Clark St. bridge in Chicago, erected in 1889, and not painted since, was quite rusty on the trusses, and much worse on the floor system. The Dearborn St. viaduct, erected in 1888, and not repainted, is in better condition than the Clark St. bridge. The Dearborn St., Polk St. and Taylor St. draws, all painted with iron oxide paints, though repainted, show little rust now or signs that many old rust spots have been repainted, and are in better condition than those at Clark and Wells Sts., although about 16 years older. The Winona bridge painted four years ago is showing signs of rust in many places, and the present indications are that this bridge, painted with red lead, will be much worse at the end of 10 years than the Blair bridge, painted with iron oxide 10 years ago, is now.

At the bridge shops it was noticed that there were rust spots on the iron before the material was manufactured, and this in spite of the fact that the metal was housed from the day of its receipt until finished, as is the case in the shops of the Lassig Bridge & Iron Works. The character of the rust spots developed in the shop corresponds exactly with the rust spots which were found under the paint in the field. A limited amount of cleaning and scraping did not do away with the rust spots entirely, and girders, after being finished and covered with oil, showed very plainly numerous rust spots scattered over the entire surface, and when the oil was scraped from these, the identical appearances were observed that were found under the paint on the finished bridges in the field.

From the foregoing observations it is evident that the oxide of iron applied to metal as a paint was not the cause of the rust found under the paint, which was the principal thing to be determined. It is further apparent that the oxide of iron which has been written and spoken against so much of late years is at least as good as any other paint which was observed. Where it was known that the paint was composed of pure pigment and pure oil, it was invariably found tough and adhering to the metal with great tenacity. It is also without much question durable, as two coats applied to one structure 11 years ago are still in practically perfect condition where the rust from under the paint had not eaten through it, and it has protected thoroughly clean metal and that which was rusted but slightly.

Lead paints, on the other hand, were almost without exception brittle, and, as compared with oxide of iron paints of the same age, were not in as good condition.

A good paint is one which is readily applied, has good covering powers, adheres well to metal, and is durable. The pigment should be inert to the metal to which it is applied, and also to the oil with which it is mixed. All of these qualities are possessed by iron oxide. It is readily mixed and applied, has covering power superior to almost any other pigment, and adhesion and durability are clearly shown in the foregoing observations. It is well known that iron oxide as found in nature is one of the most durable substances, and it has been shown that it has no affinity whatever for oil, in fact this is a feature sometimes used as an argument against it. The lead paints, on the other hand, do not mix well, and hence are difficult to apply. They have an affinity for oil, which causes them to set rapidly, making it necessary to apply them before setting, for, if not, the paint is worthless. Probably on account of the rapid drying, these paints are usually brittle, and do not adhere well to iron, and they are more readily attacked by the action of the atmosphere and its vapors and gases than some other paints.

More important, however, than the quality of the paint, is the condition of the metal before any paint is applied. Under present conditions rust exists on all structural metal as it leaves the shops, regardless of where it is manufactured, and it is very seldom cleaned properly before painting, although nominally this is required. To obtain good results from painting, absolute cleanness of metal is the first requisite, and this should be accomplished in the bridge shops by some mechanical or chemical means, such as scrapers operated by power, the sand blast, or by pickling. So long as cleaning is done by hand, it will not be properly done.

Under present conditions it is desirable to oil metal in bridge shops rather than to paint it, inasmuch as oil is not an opaque covering, and the condition of metal shows for itself and can be improved after erection and before painting, if necessary.

* Abstract of a paper to be read before the American Society of Civil Engineers, May 1.

2,500-HP. HOISTING ENGINE FOR THE QUINCY MINING CO., HANCOCK, MICH.

(With Inset.)

We show on our inset sheet this week a plan and sectional elevation of a two-cylinder horizontal hoisting engine built for the Quincy Mining Co., of Hancock, Mich., by the E. P. Allis Co., of Milwaukee, Wis. This engine has 48 × 84-in. cylinders and a 26-ft. diameter drum, and is the heaviest and largest engine of the kind ever built by this company. It will hoist from a shaft 7,500 ft. deep making an angle of 52° with the horizontal.

The general appearance and construction of the engine are shown by the drawings. The connecting rods are connected directly to cranks on the shaft of the winding drum. The cylinders measure 48 × 84 ins. and have Reynolds-Corliss valve-gear. The engine will work under from 100 lbs. to 125 lbs. steam pressure and will ordinarily run at about 32 revolutions per minute. At this number of revolutions the piston speed is 448 ft., and the power developed about 2,500 HP. The engine is reversed by steam power.

The hoisting drum is a cylindrical grooved drum with a 15-ft. face and 26 ft. pitch diameter, and is very solidly built of wrought iron and steel. There are three sets of arms—one on each side of the drum and one at the center. These arms are double extra strong hydraulic pipe, fastened into steel sockets at the outer ends. The surface of the drum is made of rolled steel plates, bent to the circle of the drum. After being put together the drum was placed in a lathe, turned all over the cylindrical surface and grooved for the rope.

The brakes are of the steam gravity type—i. e., the brake cylinders are constantly filled with steam holding the brake off the drum. When it is desired to operate the brake, steam is shut off the brake cylinder and the weight of the brake lever comes into operation. By this arrangement, the brake is always ready to act, and does not depend upon any steam appliance to make it operative.

The hoisting speed of the engine is from 2,500 ft. to 3,000 ft. per minute, which is all that is considered safe with the shaft at an inclination of 52°. The load and weight of the rope combined is 15 tons, and two skips are used, the one balancing the other. We are indebted to the Edw. P. Allis Co., Milwaukee, Wis., the builders, for the blueprints from which our illustrations have been prepared.

LEGAL DECISIONS OF INTEREST TO ENGINEERS.

Mechanic's Lien on Water-Works.

A mechanic's lien on the ground of public policy, does not extend to the valves constituting a part of the water-works of a corporation organized to furnish a city with water. For the same reason the lien does not extend to the plant of such water-works company, since, as the statute does not extend the lien to a "franchise," the purchaser of the plant would be without authority to continue the operation of the plant.—Chapman Valve Mfg. Co. v. Oconto Water Co. (Sup. Ct. Wis.), 60 N. W., 1004.

Mechanic's Lien for Labor on Canal.

A party constructing a branch or section of a main canal, or performing labor in its construction, under the contract with the owner, is entitled to a lien upon such branch or section for any balance due him for such labor.—Creer v. Cache Val. Canal Co. (Supr. Ct. Idaho), 38 Pac. Rep., 673.

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The question of the best paint for the protection of ironwork is attracting a great degree of interest nowadays; and the paper by Mr. Emil Gerber, M. Am. Soc. C. E., an abstract of which is given in another column of this issue, ranks as one of the most important contributions that has been made to this subject for some time. In the search for data on this question one fact is worth two theories. Mr. Gerber has been collecting facts, and unless somebody can upset those which he presents, it looks as if a good many specifications for bridge painting would have to be rewritten. In brief, Mr. Gerber finds by the examination of bridges painted with various sorts of paints that the much-praised red lead paint is a very poor protection for structural metal, and the much-maligned oxide of iron paint is a very good protection. The theory that oxide of iron exerts a corrosive effect on the metal on which it is placed appears to have received a severe blow at Mr. Gerber's hands.

The late reported accident on the Manchester ship canal heads another chapter in the history of that ill-fated enterprise. According to the report cabled to this country, the lower gates of the Latchford lock were completely carried away by a steamer striking them, and the vessel passed through and dropped 16 ft. to the lower level, sustaining serious damage, as might be imagined. If this rumor be true, and it is yet undenied, the accident will be used for all it is worth by the advocates of lockless or sea-level ship canals, at Panama and elsewhere. The statement that the "Herold" entered the Latchford lock "at full speed" may be dismissed as very improbable and as an unnecessary incident in accounting for the disaster. If the steamship were moving at any rate of speed, however slow, when she touched the gates, the destruction of the gates would probably have followed; and herein lies the serious problem with which engineers have to deal in planning locks for the passage of large steamships. With an 8,000-ton ship an almost imperceptible movement is sufficient to do great damage to masonry or to any other engineering construction with which it may come in contact, as was illustrated some years ago in New York Harbor, when a very slowly-moving steamship thrust her bow 8 ft. into a concrete-backed granite wall at the Battery. On the other hand, the largest ocean steamers are almost daily handled in the Liverpool docks, and though minor accidents do occur, as yet no serious damage has been done to docks or shipping at that point. The Manchester accident, however, should, and probably will, be most carefully studied, as being the first serious case in an actual ship canal with locks. The docking of large steamers at the end of a voyage, and the somewhat hurried passage of large steamers through locks in the ordinary rush of transit, are two distinct problems, and the design and protection of locks on ship canals may need some very careful study and radical revision in this connection. The handling of large steamships in canals with locks is a novel departure as yet, and every object lesson in this direction is worth careful study by engineers.

The bids for a new water supply received by Jersey City on March 25 and published in our issue of March 28 have elicited much comment on account of the high prices asked. The fact is, however, that nothing but high bids and very few offers could have been reasonably expected under the specifications, as was pointed out in these columns before the bids were presented. Only two parties submitted bids which have been taker into consideration by the authorities: The East Jersey Water Co. bid under the specification which called for a 60,000,000-gallon pumping plant delivering water at the present Belleville low-service reservoirs; the Jersey City Water Co. made a proposal under the call for a gravity supply to deliver at the present high-service reservoirs; each company agreed to furnish 50,000,000 gallons a day. The specifications contained this clause:

> Any proposal not complying with all the requirements will be deemed informal and rejected.

The bid of the East Jersey Water Co. failed to comply with the specifications on a number of points, four of which were as follows:

(1) The call was for water delivered by pumping into the Belleville reservoir, but the company's bid is for a supply pumped to a reservoir at Great Notch, and delivered from there to Belleville by gravity. (2) A pumping capacity of 60,000,000 gallons was specified, but the bid is for 30,000,000-gallon pumping capacity at the start, pumps to be added to keep the plant 10,000,000 gallons ahead of the consumption. (3) The specifications provide that the contractor must not supply water to any other consumer, but the bid states that compliance with this clause is impossible, although a plant will be provided exclusively for Jersey City. (4) The specifications require each bidder to name and the successful bidder to maintain a standard of purity for the water furnished, but the East Jersey Water Co. will only agree to do all in its power to maintain the purity of its source of supply.

It is true that these variations from the strict letter of the specifications might conceivably be permitted without seriously affecting Jersey City's welfare, but they would probably make an award to the East Jersey Water Co. impossible without more or less legal delay and complication; further, the prices named by the East Jersey Water Co., all things considered, are materially higher than those of the other bidder, and there are difficulties in the way of the proposed eventual transfer of the works to the city. For these reasons it seems altogether unlikely that the award will be made to this company.

Under the other bid, that of the Jersey City Water Co., assuming that only one supply main will be put in, 20,000,000 gallons of water daily would be furnished the city for $39.75, and 50,000,000 gallons for $34.40 per 1,000,000 gallons, with intermediate prices between these quantities. The works would be sold to the city for $8,500,000. This is for works capable of delivering 50,000,000 gallons daily to the city's high-service reservoirs 210 ft. above mean high tide. According to statements of the company, a storage capacity of 11,784,000,000 gallons would be provided by it and the pipe line would be 29 miles in length.

Is the price asked by the Jersey City Water Co. an exorbitant one? With reference to this Mr. J. J. R. Croes, M. Am. Soc. C. E., in a report made by him on April 4 to the Jersey City Board of Trade, makes the following statement:

> For works of a capacity of 60,000,000 gallons daily, a fair and just value would be $4,500,000, and a fair charge per million gallons delivered would be $12. These estimates include all payments for water rights.

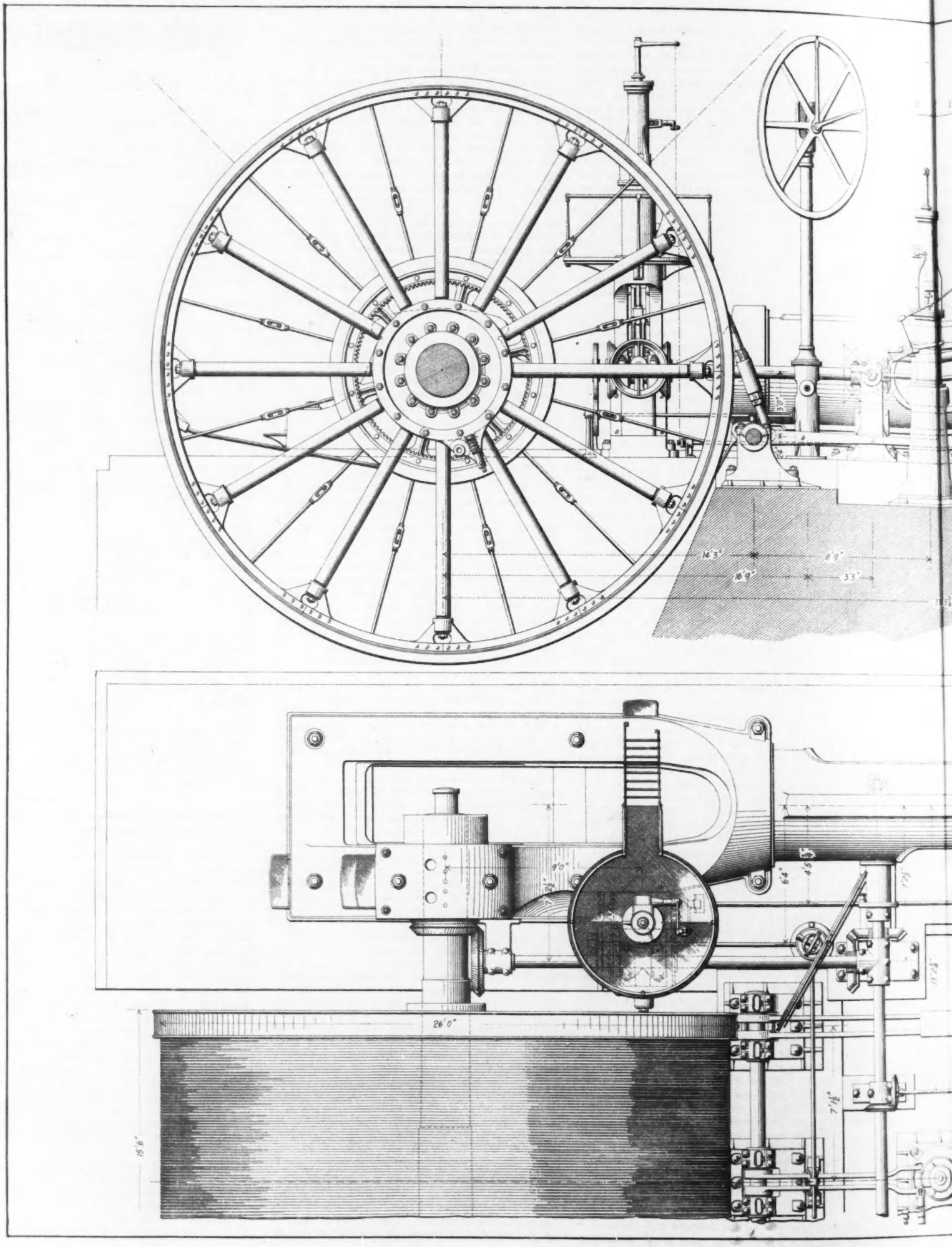
There is thus a difference of $22.40 per million gallons in the price of water and of $4,000,000 in the value of a plant, between the company's offer and Mr. Croes' estimates. It seems likely that this difference is mainly due to the following factors: (1) The company has put a tremendous value on its water rights, intending to co-operate with syndicates which have been working for years to take advantage of the necessities of the people of this section of New Jersey by securing control of the most available sources of water supply. (2) Mr. Croes estimates the water rights on the basis of the damage which would arise to present actual users of the water if the latter were diverted from its present sources. (3) Through apparent utter lack of efficient engineering and legal advice, the city put out specifications so drawn as effectually to narrow competition and place the city at the mercy of the water-right syndicates above referred to.

If the Jersey City authorities really desire a supply of pure water at a reasonably low price, they should employ the best hydraulic engineers and the most competent legal experts on water-rights obtainable to study the possible sources of supply for the city in all their engineering and legal phases.

It is not apparent, to an outsider at least, that it is impossible for Jersey City to secure a pure water supply by seeking and condemning proper sources and building its own works, as other cities do. It might thus avoid the payment of millions of dollars to the speculators who have attempted to control the potable water supplies of Northern New Jersey.

The series of tests of paving brick, which we publish in another column of this issue, seem to bring out one or two facts in connection with the testing of this important material which are deserving of special mention. The testing of paving brick is analogous to the testing of hydraulic cement, in the respect that the test is made not so much to determine the actual strength of the material in use as it is to determine the quality of the material. A vast number of previous tests has shown, within reasonable limits, that a cement, which will withstand certain tests is pretty certain to satisfy the ordinary demands of construction, and in the same way previous tests of paving brick are coming to establish, perhaps not so closely, but still within certain limits, the quality of that material. It is an imporant thing, therefore, that all tests of paving brick, as well as all tests of cements, should be comparable, and in order to be comparable, these tests must be reasonably uniform. A glance at the tables published on another page shows that there is a considerable lack of uniformity in paving brick tests, and in the various other records of brick tests there referred to this lack of uniformity is further emphasized. From the nature of the tests, considerable uniformity has already been reached, as far as the crushing and transverse strength of paving brick are concerned, but the far more important tests of abrasion and absorption are not at all uniform. A member of the staff of this journal recently heard a prominent paving brick manufacturer make the statement that he had satisfied six different specifications for abrasion and absorption tests from as many different cities with bricks from the same kiln, by using a little care in selecting the bricks. These bricks were to be subjected to practically the same conditions of traffic, temperature, etc. Now, it is true that bricks taken from one part of a kiln are very different from bricks taken from another part, but at the same time it is equally true that if the bricks taken from certain parts of a kiln are the best for paving purposes, those taken from other parts are not so good, providing the conditions of use are the same. Either five of the cities supplied by this manufacturer got poorer bricks than the other one, or else five of the tests specified were of little use in determining the best bricks. It will not be attempted here to determine the best form of tests for paving brick, even if it can be determined with our present knowledge, but it needs little argument to show that if such definite tests can be determined in the near future, some more uniform practice in conducting tests should be adopted. There is, moreover, every reason to believe that the average manufacturer would hail such uniform tests with joy.

Another fact brought out by the tables is the decreasing use of large bricks, 4 × 5 × 12 ins., or


14'3"
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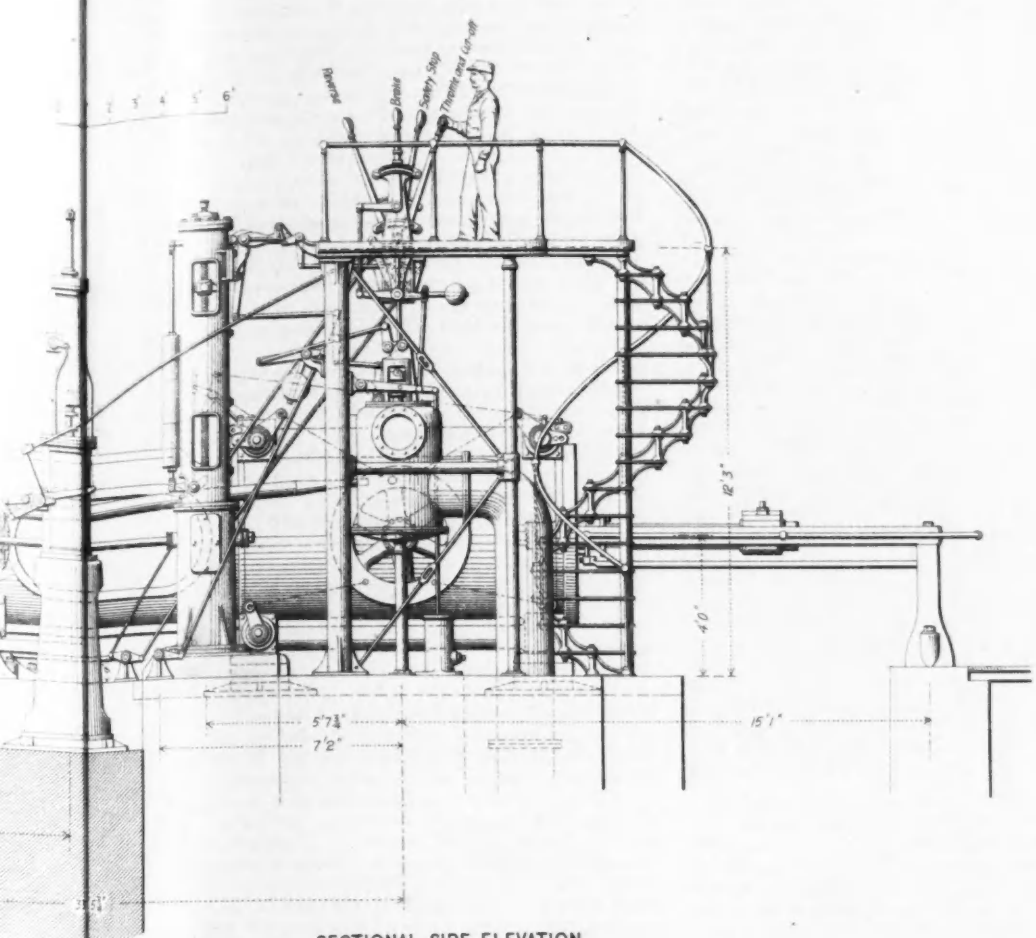
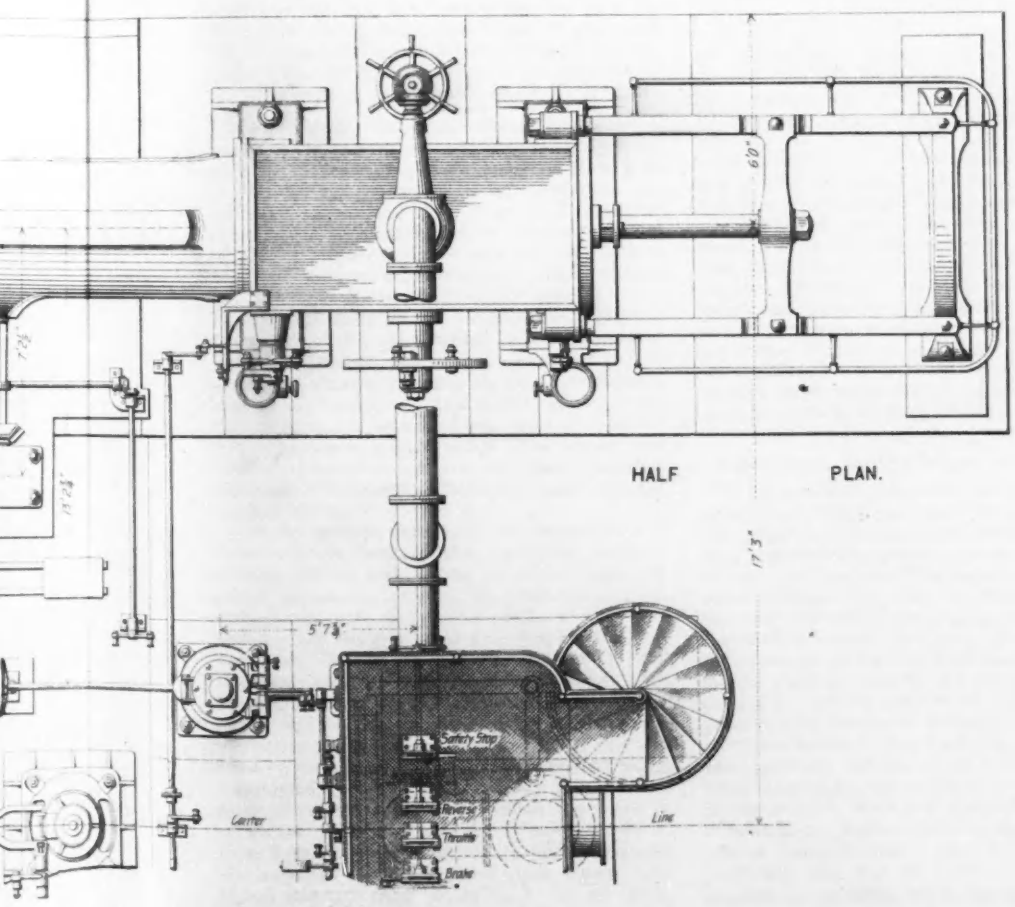
9'0"
26'0"
15'6"
7½"



SECTIONAL SIDE ELEVATION.



HALF PLAN.

MINE HOISTING ENGINE,

2,500 HP.,

QUINCY MINING CO.,

HANCOCK, MICH.

The Edward P. Allis Co.,

Milwaukee, Wis.,

Designers and Builders.

CHAS. HART & SONS, LITH., 99 VESEY ST., N. Y.

paving blocks, as they are commonly called. With the exception of one short series of tests, made at Peoria for experimental purposes, all the tests were made with the small or building size, 2½ × 4 × 8 ins. of paving brick. Commercial as well as engineering reasons have contributed to bring about this change from a very large use of large paving blocks to an almost universal use of small bricks. The large blocks proved to have less transverse strength, and to be more difficult of uniform and homogenous vitrification, and, when laid, to be more liable to become loosened than the smaller brick. The claim that pavement could be more rapidly laid with them did not prove entirely true. The tiring effect of handling the heavier block was found to counterbalance to a great extent any gain which was obtained by the block covering a larger surface. Commercially the reasons were still stronger for abandoning the large paving block for the smaller brick. A certain proportion of the brick in each kiln were unfit for paving, and when the 2½ × 4 × 8-in. brick, however, better terms could be made, as they were capable of use as backing brick in buildings and other structures in connection with the regular commercial building bricks. The manufacturer being able to sell his seconds at a reasonable price, could therefore reduce the price on the better qualities, or the paving brick proper. In the light of present knowledge, therefore, this reduction in the size of paving brick to the dimensions of building brick is beneficial in nearly all respects. This question has nothing to do with the "skinning" in size of building brick, which we have deprecated in previous issue (Eng. News, Dec. 13, 1894); it only realizes the fact that whatever may be the size of building brick, it is advantageous from a commercial point of view to have the size of paving brick correspond to it closely.

Since the above was in type we have received from Prof. J. B. Johnson, M. Am. Soc. C. E., and publish in another column, a valuable discussion of the subject of standard tests for paving brick. This is especially pertinent at the present time, and will doubtless be given careful study both by paving brick manufacturers and by those interested in its use. Features worthy of especial attention are the determination of the best average test described in the last few paragraphs, and the discussion of the character and value of absorption tests. The belief seems to be growing among engineers that the rigid limitation of absorption to 1 per cent., or at the most 2 per cent.,is not advisable.

It was a most picturesque scheme that the newspapers of the country gave publicity to on April 1—an elevated electric railway to run from New York to Chicago, and eventually to San Francisco, for the carrying of coal and grain. The capital stock was $200,000,000, for the charter was filed in Illinois, where it costs only a dollar and a half, we believe, no matter how many ciphers are attached to the "authorized" capitalization. It was to be elevated, the incorporators explained, "to do away with the necessity of buying right of way." Of course, everybody knows that it is a great deal cheaper to build an elevated structure than to buy farm lands for a railway right of way. Electricity was to be used, it was stated, because "it is cheaper as a motive power than steam, and renders a much higher rate of speed possible," which again is something that every fake promoter, at least, is entirely certain of.

But that project, dazzling as are its prospects to those who are familiar with the profits made by existing railway lines in the carriage of coal and grain, is entirely eclipsed in point of gorgeous magnificence by the scheme with a Rochester inventor has recently made public, and which has been published in extenso by the Buffalo and Rochester papers. This scheme is, in brief: "To build a mighty building over the rapids of Niagara, and utilize the power of the the river for generating electricity enough to supply all the cities of the United States and Canada with power —unlimited power." This building is to extend from Goat Island to the Canadian shore, 40 ft. above the Horseshoe fall, and is to be "2,640 ft. long, 1,600 ft. wide and 804 ft. high, supported and anchored by two immense stone towers, each placed 900 ft. from either bank, 48 ft. thick, 1,600 ft. wide and 420 ft. high, each weighing 600,000 tons." There is a delightful indefiniteness in this account of how the structure is to be supported, but that doesn't matter with a scheme of such proportions. The main thing, of course, is the decoration, and on this point explicit information is given. It is to be:

> Ornamented with Mexican onyx, with immense pillars of the same stone. On the front of the south wing will be the words in aluminum, "United States," and on the Canadian side will be the letters, "Ontario, Dominion of Canada." The central part will have over the entrance the Latin word "Unitarius." Over the American part will fly the United States flag and over the Canadian part the British flag.

In addition, we learn that the inventor has "discovered a plan of transmitting electric currents any distance without loss of energy, a thing which has been puzzling electricians for many years." This is highly interesting news, and if true would certainly furnish the inventor with funds to build anything which even his fertile brain could plan.

Why reputable journals should take space to print such Munchausen dreams passes comprehension. This story is such a stupendous "fake" that probably only a small percentage of newspaper readers would place any reliance upon it; but, on the other hand, similar nonsensical tales, somewhat less highly colored, relating to new schemes and projects, are printed almost daily in reputable newspapers, and are taken for honest truth by the majority of newspaper readers. As the great mass of business men and investors rely on the newspapers for their knowledge of technical matters, it is small wonder that with such instruction, the promoters of wild-cat schemes of all sorts which promise vast profits, find plenty of victims, while those who seek capital for legitimate enterprises, promising only ordinary business profits, too often seek it in vain.

The promoters of the "electrical current distributor" scheme, referred to in our issue of Aug. 23, 1894, appear to be still traveling eastward, and are now giving an opportunity to the good people of Boston to invest in their enterprise. As briefly described in our former review of this scheme, it purports to be an "electric horsepower multiplier," by which a given amount of electrical energy is made to light three or four times as many lamps as are ordinarily lit. The lamps are arranged on separate circuits and the current is rapidly switched from one to another in succession. The promoters are now widely advertising a "test" in which it is averred that 150 lamps (rated at 16 c. p.) were lit by current from a 7-KW. dynamo driven by a 12-HP. Ideal engine, and that the coal consumption was 500 lbs. in five hours. Inasmuch as 150 lamps of good efficiency give a load but little in excess of what this engine and dynamo are rated for, and as any well-designed engine and dynamo can work at a considerable percentage above its rated capacity, it is evident that the much-boasted feat could be duplicated without the aid of any of the "current distributors" and other paraphernalia with which these promoters are juggling. To an engineer the fact is apparent that the promoters of this scheme are simply working on another phase of the same old "perpetual motion" idea, which has aided the transfer of so many dollars from the pockets of guileless investors to those of guileful promoters.

VERTICAL LIFT-LOCKS FOR CANALS.

On all canals having locks the traffic capacity or carrying capacity is controlled by the locking capacity, except in cases where the traffic is very slight. However fast the vessels or barges may be able to traverse the reaches of the canal, they must slow down to enter a lock, and are then detained during the time required for closing the rear gate, letting the water in or out, and opening the front gate, and the aggregate of the time consumed in these delays may be a serious proportion of the time required for passing through the canal if the changes of level are great and the number of locks is large. On nearly all barge canals having traffic of any importance, the experience has been that within a few years after completion the traffic begins to exceed the accommodation, while at the same time there comes a demand for greater economy in operation or in cost of transportation. As a consequence, larger boats are used, and the boats are run as double-headers, or in fleets, while mechanical power for propulsion begins to be introduced, the idea being to increase the speed and the carrying capacity in order to secure greater accommodation with a reduction in expenses. These measures may be carried on until limited by the width and depth of the canal, which, however, may often be increased to some extent at comparatively small expense, but the principal controlling feature of the capacity of the canal is the size of the locks, and when this limit is reached, there at once comes up the question as to how to increase the lockage capacity with a reasonable expenditure of money, proportionate to the importance of the canal and its traffic.

Another consideration in regard to the locks is the water supply of the canal, for to double the length of the locks means using twice as much water at each lockage. These considerations affect not only existing canals, but also new canals, where the amount of traffic, the great changes in level or the limited amount of water supply available makes the design of the locks a most important matter.

In ordinary cases, where only one or two locks are involved, and where the supply of water is ample, the lengthening and enlarging of the locks may be carried out with comparative ease, but when the supply of water is limited or only sufficient for present needs this may be inexpedient, and where a series of consecutive locks has been built to effect a change of level of 40 to 150 ft., the lengthening may be practically impossible. Under such circumstances some new method of dealing with the problem must be found, if any greater capacity is to be provided. In solving such a problem, moreover, in cases where the traffic is already taxing the existing capacity, it must be borne in mind that whatever arrangement is adapted the installation should be made with as little interruption to traffic as possible, and therefore, in cases where the canal is closed for navigation for the winter season, the installation should be made, as far as possible, during the months when the canal is thus closed.

This question of lock improvement has recently assumed importance in connection with the improvement of the Erie Canal, by far the most important artificial waterway in the United States. The original canal was only 4 ft. deep and 40 ft. wide on the surface, carrying boats of 80 tons capacity, but the width has now been increased to 70 ft. and the depth to 7 ft. (the latter will probably be further increased to 9 ft. eventually), while the present boats are about 100 ft. long and have a capacity of 250 tons. In 1885 the work of doubling the length of the locks was begun, not so much to enable the number and size of the boats to be increased as to expedite the traffic and enable the boats to make a larger number of trips in each season, thus enabling the canals to compete to better advantage with the railways. The bulk of the traffic on the Erie Canal is now carried on by "double-headers," or two boats connected together as one long boat, and there has been a great increase in the number of steam canal boats, which tow or push from one to five consorts, while the introduction of electric traction or towage, which seems to be a probability, will also increase the carrying capacity of the canal by increasing the speed in the open reaches between the locks. In the case of a double-header the time of locking is reduced one-half by doubling the length of the locks, to say nothing of the saving of time in disconnecting and reconnecting the boats.

The Erie Canal is 363 miles long, and has 72 locks, of which 40 have been lengthened from 110 ft. to 220 ft. (or about 210 ft. in the clear), at an average cost of $30,700 for each lock. Of the 32 locks yet to be dealt with, many are bunched in groups or flights, so that in some cases the work of lengthening is practically impossible, as, for instance, at Cohoes, N.Y., where a change of level of 140 ft. is effected by 16 locks (some of which are separated by short level stretches), and at Lockport, N. Y., where five locks effect a change of 50 ft. The lift of the locks averages 8 ft. to 10 ft. Apart from the engineering difficulties of the work of lengthening these flights of locks, the great cost, the delays to traffic, and the question as to the sufficiency of the water supply are very important considerations. It would, of course, be impracticable to do the work in the five months available between two seasons of navigation, and the boatmen would, of course, oppose any works which would, even temporarily, cur-

tail the number of trips they can make in a season, as at the present time the number is barely sufficient to enable them to make a living profit. The solution which is proposed for this problem by Mr. Campbell W. Adams, the State Engineer, is described in another column, and consists, in brief, of a vertical lift-lock designed to replace the flight of five locks at Lockport; and eventually a structure of similar design will probably be erected to replace the flight at Cohoes.

In view of the interest excited by this proposed work, and also in view of the interest felt in the matter of the locks for the projected Nicaragua Canal,and for the proposed ship canal from the Great Lakes to the Hudson River, and other proposed important artificial inland waterways,we have collected and present herewith a review of the various substitutes for flights of ordinary locks which have been proposed or tried. All such substitutes may be conveniently divided into the following four classes: First, ordinary locks of great lift; second, inclined planes over which the boats are hauled on cradles; third, inclined planes over which the boats are hauled in troughs full of water; fourth, vertical lift-locks, in which a trough or lock chamber is raised vertically from one level to the other.

As to the first system, a high-lift water lock was patented in this country in 1867 by Mr. Horace H. Day, who proposed this system for effecting the navigation of the Niagara River. The lock chambers were to be shafts excavated in the bluffs near Lewiston, and having tunnel approaches. The patent also covered storage chambers for the purpose of economizing in the water supply for locking. A water lock of 65.6 ft. lift for barge canals was proposed in 1891, by Mr. Fontaine, a French engineer, the objects of which were to shorten the time of locking and to avoid the waste of the entire contents of the lock at each operation. The lock chamber was 126.28 ft. long and 17 ft. wide, and in each side wall were three tiers of culverts and storage chambers, the two chambers of each level having a capacity equal to 13.12 ft. depth of water in the lock. In brief, the operation was as follows: The descending boat entered the full lock, and the upper gates were closed. The water was then drawn off into the first tier of chambers, lowering the boat 13.12 ft., and so on until by five successive stages the water reached the level of the lower part of the canal, when the boat was let out through an arched opening in the end wall. An ascending boat having then entered the lock, and the opening having been closed by a gate, the water was readmitted from the storage chambers stage by stage until the upper level of the canal was reached. This system was described and illustrated in our issue of Sept. 19, 1891.

The second system, in which the boats rest upon cradles, which are hauled up inclined planes, has been in use in England for more than a hundred years, some of the inclines having grades of 10 and 12 per cent., while the Lake Biwa canal, in Japan, completed in 1890 (Eng. News, April 13, 1893), has a plane with a rise of 118 ft. in 1,815 ft., or about 6½ per cent. In this country inclined planes were adopted on several of the old canals. The Portage Railway, in Pennsylvania, was built to carry sectional canal boats between two divisions of the Pennsylvania Canal. On the Morris Canal, in New Jersey, the inclined-plane system is still in use, and some particulars of its operation will therefore be of particular interest. The Morris Canal was commenced in 1825, and completed to Newark in 1831, and to Jersey City in 1836. It was originally 20 ft. wide at the bottom, 32 ft. wide at the water line, and 4 ft. deep, with locks 9 × 75 ft., the traffic consisting of boats of about 20 net tons capacity, drawing 3 ft. of water. Of the 23 inclined planes, 20 were "summit planes," the grade being carried up over the embankment at the end of the canal and then sloped down into the water, while the others were "lock planes," the grade ending in shallow locks into which the boat was run to be deposited upon or raised from its cradle. The summit planes were soon changed into lock planes on account of an increase in the length of the boats. In 1841 the planes were widened and the locks enlarged to 11 × 95 ft., and in 1845 work was commenced on the enlargement of the canal to a width of 25 ft. at the bottom and 40 ft. at the water line, and a depth of 5 ft. At the same time section boats were introduced, having the two parts connected or hinged by heavy iron bars at the deck level, and the boats having a freight capacity of about 50 net tons. As these boats could easily pass the summits, and as summit planes are more convenient and less expensive to operate than lock planes, all the planes were gradually converted into summit planes between 1850 and 1860, at which latter time boats were introduced of about 78 tons freight capacity, which is about the capacity of the present boats, drawing 4 ft. of water. Between Newark and Phillipsburg, 75 miles, there is a total rise and fall of 1,674 ft. (914 ft. up from tide level to the summit level, and 769 ft. down to the Delaware River). Of this total, 225 ft. are effected by 23 locks and 1,449 ft. by 23 inclined planes, the average grade of which is 10 per cent., and the average rise 58 ft. A few of the planes are double track, but most of them are single track, with rails laid to a gage of 12 ft. 5 ins. The boats are in two sections, as already noted, and the car or cradle is also in two sections, each part being 32 ft. long over the sills and carried on two four-wheel trucks, with 29-in. double-flanged wheels. At present the traffic amounts to about 1,500 or 1,600 tons per day.

The third system is similar to the above, except that the cradles are replaced by tanks or troughs, so that the boats are water-borne during the transfer and thus escape the liability to racking and injury incident to the cradle transfers. This system is in operation on the Monkland canal, in Scotland, where the plane rises 96 ft. with a grade of 10 per cent., the hoisting being done by two steam engines of 25 HP. The maximum weight hauled is about 80 tons and the transfer occupies 10 minutes. About 7,500 boats pass this incline annually. These systems, however, are not used to any extent, and are not applicable to large boats or very heavy traffic. All these planes (of both second and third systems) have their axes coincident with the axis of the canal, but in 1890 Mr. Flamant described in "Le Genie Civil," of Paris, an inclined plane system at right angles to the line of the canal, the boat being carried in a water-filled trough moving sideways and operated by rack rails and gearing. The details were worked out by Mr. Basseres, engineer of the Fives-Lille ironworks, but the plan has apparently never been put into actual use.

The fourth system, in which vertical moving troughs or lock chambers are employed, is the one best adapted for heavy work, and has already been applied abroad on a large scale. Among the advantages of this system, as designed for the Erie Canal, are that it can be introduced without interfering with traffic and without involving any material reconstruction of the existing works, neither of which advantages can be claimed for the other systems considered.

In the vertical lift-lock system the boat is floated into a movable trough, the ends of which are closed by gates, while similar gates close the ends of the canal approaches. When the gates are closed behind the boat, the trough is raised or lowered, as the case may be, until it coincides with the other level of the canal, when the front gates are opened and the boat proceeds upon its way. The height of lift is, of course, a minor consideration, and a boat can be raised or lowered through a distance which would require several locks, in less time than would usually be required to pass through one ordinary lock. The system, or at least its principle, is by no means a new one, having been applied many years ago (though subsequently abandoned) on the Grand Western Canal, of England. In this early example, there were two masonry lock chambers, side by side, each containing a timber cradle and being provided with end gates. The cradles were connected by three chains passing over wheels supported by an overhead framing over each chamber, and were balanced or in equilibrium when full of water, or when either one or both cradles contained a boat. An excess of 2 ins. in depth of water in the upper cradle gave sufficient preponderance to lower it, thus raising the other cradle. The boats weighed 8 tons, and the lift of 46 ft. was made in 10 minutes, using only two tons of water, while in the ordinary way three tons would have been required. In a somewhat similar plan, described in Creasy's "Theory and Practice of Engineering," one cradle was used as a water counterbalance for the one carrying the boat.

The first vertical lift on a large scale was that designed by the late Mr. Edwin Clark, M. Inst. C. E. (and built by the firm of Clark, Stanfield & Clark, of which he was a member), for use at Anderton, England, to connect the barge navigation on the River Weaver with the Trent & Mersey Canal, the difference of level being about 50 ft. from the river up to the canal. The adoption of some such system was made necessary by the facts that the location was not favorable to the construction of a flight of ordinary locks, and that there was not a sufficient supply of water for feeding such locks. This lift-lock consists of two iron troughs, 75 ft. long, 15 ft. wide, and with 5 ft. depth of water. These troughs are side by side, each resting on a pair of longitudinal cantilever main girders, supported under the middle of the trough by a vertical hydraulic plunger or ram 3 ft. in diameter, moving in a cylinder sunk below the bottom of the lock chamber. The two cylinders are connected by a 5-in. pipe near their lower ends, this pipe being fitted with valves. When one trough is at the upper level, the other is at the lower level, the cylinder of the former being full of water and the valves closed. If both troughs are equally loaded, then when the valves are opened to effect communication between the two cylinders, the upper trough will sink and the lower one will rise until they are in equilibrium at the middle of the stroke, or the middle distance between the two levels. In practice, however, the upper trough is given a greater weight, or "surcharge" (by a slightly greater depth of water) so that the troughs come into equilibrium at the end of the stroke. At the bottom level, the trough drops into the river, and as the water offers an extra resistance,thus practically reducing the weight of the descending trough in proportion to the depth of its immersion, a 10-HP. engine (with accumulator) is used to complete the stroke, this engine doing about one-twelfth of the work, the rest being done automatically. The time occupied is about eight minutes for a complete operation, and as the time required to effect a lift of the same height at Runcorn by a flight of six locks is from 1 to 1½ hours, it will be at once seen how greatly the capacity of lockage is increased, while at the same time the amount of water used is merely that of the excess depth in the descending trough, which, in this case, amounts to about 17 tons, instead of the entire contents of an ordinary lock chamber. Each trough can, if necessary, be operated independently by the engine, but in such case the lift occupies about half an hour. The work was commenced in 1872 and completed in 1875. The foundations, masonry, and approaches cost $94,800, and the ironwork and machinery of the lifts, $147,200, making a total cost of $242,000.

The next application of this system was on the Neufosse Canal, in France, the traffic on which had in 1882 become so great (13,000 boats per year) that at the flight of five locks at Les Fontinettes, near St. Omer, it became necessary to pass boats in one direction only during each day, ascending and descending boats using the locks on alternate days. The height of lift was 43 ft. 1 in. In 1882, therefore, the French government decided to adopt a Clark vertical hydraulic lift-lock at this place, similar to, but of larger size than, that at Anderton. The two troughs are 129 ft. 7 ins. long and 18 ft. 4½ ins. wide, with 6 ft. 10⅝ ins. depth of water. The plungers are 6 ft. 6¾ ins. diameter, and the cylinders are connected by a 9¾-in. pipe. The weight of each trough, including water and plunger, is 879 tons. At the lower level the descending trough enters a dry lock chamber, thus avoiding the variation of weight which has to be provided for at Anderton. A 15-HP. turbine drives pumps which charge the accumulators for supplying the water by leakage from the cylinders, for pumping out the dry chambers, and for operating the gates and capstans. The excess amount of water in the descending trough is 16 ins., or equivalent to a weight of about 98 tons, but automatic release valves stop the trough if it should pass the proper limit of the stroke. The time of lifting is from 5 to 7 minutes, and the complete lockage occupies about 20 minutes, while by the old flight of five locks it required about two hours to transfer a boat from one level to the other. With one trough worked independently of the other by the turbine, the time occupied in lifting is about two hours. This lift was opened in 1885. The cost of lifts and machinery was $166,000, while the total cost, exclusive of land, was $341,000.

The third, and, so far as we know, the latest ap-

plication of the hydraulic lift-lock, was on the new Canal du Centre, in Belgium, which was built in 1882, and for which the Belgian government decided to adopt four locks on the Clark system. The canal is only 13 miles long, but has to overcome a change of level of 217 ft. in nine miles, so that locking on the ordinary system was impracticable, especially as the amount of water available was very limited. The first of the locks installed was that at La Louviere, opened in 1888, and the other three are similar, except that one has a lift of 63 ft. 7¾ ins. The La Louviere lock is similar to that at Les Fontinettes, but is somewhat larger. The troughs are 141 ft. 1 in. long and 19 ft. wide, with 8 ft. 6 ins. maximum depth of water, and the rams are 6 ft. 6¾ ins. diameter, with a stroke of 50 ft. 6¼ ins., while the weight of trough, water and ram is about 1,161 tons. A dry-lock chamber is provided at the lower level. Two turbines of 69 HP. each supply the accumulators and work the various machinery for gates, capstans, etc. The excess depth of water in the descending trough is 10 ins. The time occupied in lifting is 2½ minutes, and the total time for lockage, including the opening and closing of the gates and the entrance and exit of the boats is 15 minutes. The cost for the lifts and machinery was $163,000; for the foundations and masonry, $76,000 (much less masonry being used for the upper works than at Les Fontinettes); making the total cost $239,400. The general dimensions of these hydraulic ram locks and of the proposed hydraulic balance lock for the Erie Canal are given in the following table.

In all these six foreign hydraulic lift-locks, each trough is supported upon a single plunger, and there is, of course, an enormous pressure, although good design and workmanship in the machinery have made the locks very safe and reliable in operation. The Anderton lock has cast iron rams 3 ft. in diameter, moving in cast iron cylinders, each ram and cylinder being made in three lengths. In 1882, after seven years' service, one of the cylinders burst, allowing the ram and trough to descend rapidy, but fortunately the water cushion prevented any serious damage. The other cylinder was then tested and burst at a pressure of 800 lbs. per sq. in., the working pressure being about 530 lbs. per sq. in. Both cylinders were then repaired, and no later accidents occurred. The Les Fontinettes lock has cast iron rams 6 ft. 6¾ ins. diameter and 2.8 ins. thick, in lengths of 9 ft. 2 ins., bolted together by inside flanges. The cylinders are of weldless rolled steel hoops 2.36 ins. thick and 6 ins. high, lined with copper, and held together by vertical bolts. The pressure is 442 lbs. per sq. in. It was originally intended to have cast iron cylinders 4¾ ins. thick, to stand a pressure of 3,600 lbs. per sq. in., but later it was decided to increase the thickness to 5½ ins. and to shrink wrought iron hoops on the cylinders. Before the cylinders were built, however, the accident occurred at Anderton, and the French engineers decided not to use cast iron. After experimenting with cast steel, wrought iron, etc., the plan was adopted of a built-up cylinder of rolled steel rings having fillets on the lower faces and grooves in the upper faces, the whole held together by rods and made watertight by a copper lining. At the La Louviere lock the rams are of cast iron, 2.95 ins. thick, made in eight sections 7 ft. long. Many experiments were tried as to the cylinders, and eventually they were made of cast iron 6 ft. 9 ins. inside diameter and 4 ins. thick. They are in nine sections and are hooped with weldless steel rings 2 ins. thick and 6 ins. high, shrunk upon them.

The reason for using but one ram to each trough was the difficulty of securing uniform resistance and motion of two plungers, but in our issue of May 9, 1891, there was described and illustrated a vertical lift-lock proposed by Mr. Petri, a German engineer, in which two rams were used under each trough (one near each end), the connecting pipes being fitted with the Hoppe valve motion for parallel lifting, as used for gasometer roofs. This, however, while giving a better support to the trough, is hardly more reliable than the single ram, especially for very large locks, and in either case the safety and reliability of the locking depends upon one or two ponderous pieces of mechanism, repairs to which would be tedious and expensive.

Another design of hydraulic lift for canals is that of Mr. Adolph Prussman, a German engineer, the special feature of which is that the use of water under pressure is dispensed with. The boat is carried in a trough provided with end gates as in other lifts, but the trough is supported by hollow cylinders attached to hollow floats moving in wells full of water, the floats being airtight and of such capacity as to just balance the trough full of water. When the trough is at its upper position a surcharge of water is admitted, and valves are opened to allow the water in the wells to enter the vertical cylinders, the movement being regulated by the opening and closing of these valves. For the upward movement enough water is let out of the trough to reduce the weight below that of the lifting capacity or buoyancy of the floats. When the stroke is nearly completed, the valves are closed and the continued motion, by raising the water in the cylinders above that in the wells, creates a surcharge by which the trough is gradually brought to rest.

We may also mention a pneumatic lift-lock proposed by Mr. Chauncey M. Dutton for overcoming the great change of level on the Niagara River by a single lift, the total difference of level being about 320 ft.

In the hydraulic lift-lock designed for the Erie Canal, as described and illustrated in another column, Mr. Adams has returned to the old balance system of the Grand Western Canal, but in place of using one trough to counterbalance the other, he makes each trough independent, having its own balances or counterweights. The wisdom of this is seen when we look at the estimated weights. One of the troughs would carry a little more water than the contents of a standard lengthened lock (1,112 tons), or say, 1,150 tons, as compared with 176 tons, 438 tons and 660 tons of water for the Anderton, Les Fontinettes and La Louviere locks respectively. The troughs would also be larger than any yet built, and if balanced on a central support would require about 2½ times as much metal as that in the La Louviere lock. Therefore, for a lock on the Clark or hydraulic ram system, of the size required for the Erie Canal, the weight would be about 2,330 tons, as compared with 1,161 tons. As will be seen by the table, the weight of metal for the balance lock is only 292 tons, and the total weight loaded only 1,442 tons. To support a trough of 2,330 tons without exceeding the working pressure of 470 lbs. per sq. in., as used at La Louviere, a ram of about 9 ft. 4 ins. diameter would be required, which, with its cylinder, would be a stupendous and costly piece of work. By the balance system the trough is supported at intervals of 5 ft. along each side, the weight being thus so distributed that any serious failure is very unlikely to occur, while repairs to or renewals of single sheaves, cables, etc., can easily be effected without interfering with the operation of the lock. At the same time it must be remembered that the troughs work independently and not in connection with each other like those of the foreign lift-locks. The expense of a great lock of the hydraulic-ram type would be very great, and its construction would occupy considerably more time than for the balance lock. Mr. Adams estimates that the proposed balance lock, complete with two troughs, can be built for $300,000, and can be erected during the five months available between two seasons of navigation.

The saving in time of locking is a most important feature of the balance lift-lock, the time being reduced from half an hour or two hours with ordinary locks (according to the number of locks) to 10 or 20 minutes, the lift itself requiring only 2 to 5 minutes. This is shown by the table in another column. As an example of the enormous saving which would be effected on the Erie Canal, it may be stated that the time now required to pass a single boat through the five locks at Lockport is about 35 minutes for an eastbound (descending) boat, and 75 to 100 minutes for a westbound (ascending) boat, the difference being due to the fact that the eastbound boats are helped through by opening the upper paddles and "swelling" the boats out. This practice is followed at all the locks, and effects a great saving in time, though it is wasteful of the water. At the 16 locks, or "the sixteens," at Cohoes, the descend is made in about three hours and the ascent in about four hours, with perfectly clear work, but as it seldom happens that all the locks are clear, the average trip consumes considerably more time than above given, while at times, when the traffic is specially brisk, it has been known to take a boat an entire day to make the passage. At both of these "bunched" locks the boats must pass singly, and, as already noted, the bulk of the traffic is in double-headers or in fleets of boats. As few, if any, of the fleets carry more than one crew, they must hire additional teams and helmsmen for each consort at these places. At Lockport the charge is about $1.50 per boat per trip, and at Cohoes it is about $5 ($3 for the team and $2 for the helmsman), which would, of course, be saved by the new lock, the boats being hauled in and out of the lock by hydraulic capstans. At Lockport there are 20 men employed to handle the locks; namely, two men for each lock, working in shifts of 12 hours, while at Cohoes 64 men are employed for the same purpose. These men work seven months per year and are paid $45 per month. Thus the amount for wages for lockmen at the first place is $6,300 per year, while the wages for the four men estimated as required for the balance lift-lock would be only $1,260, thus effecting a clear saving of $5,040. At the Anderton lift-lock in England, four men are required, while at the larger locks at Les Fontinettes and La Louviere only three men are required.

Sufficient has been said to show the importance of lift-locks for the Erie Canal. The amount of traffic on this canal, together with the reduction in rates and the consequent difficulty for the boatmen to make a living unless the traffic is expedited so as to enable them to make more trips each season, will warrant considerable expenditures in further extending the improvements already instituted, and one of the most important improvements is undoubtedly that by which the time of locking can be reduced from hours to minutes. The advantages of the vertical lift-lock system generally may be enumerated as follows: 1. Saving in time of locking; 2, saving in water used at each lockage; 3, saving in number of men and cost of operation. To these may be added the following special advantages for the balance lift-locks for the Erie Canal: 4, short time of construction; 5, low cost of work; 6, little interference with existing works.

Hydraulic Lift Locks.

	Anderton, England.	Les Fontinettes, France.	La Louviere,* Belgium.	Lockport, N. Y., United States.
Date of opening	1875.	1885.	1888.	....
Type	Hyd. ram.	Hyd. ram.	Hyd. ram.	Hyd. balance.
No. of troughs	2.	2.	2.	2.
Length of trough	75 ft.	129 ft. 7 ins.	141 ft. 1 in.	225 ft.
Breadth " "	15 "	18 " 4½ "	19 " ¼ "	19 ft. 2 ins.
Depth of water	5 "	6 " 10⅝ "	8 " 6 ins.	9 ft.
Height of lift	50 ft. 4 ins.	43 " 1 in.	50 " 6¼ "	54.43 "
Weight of boats, tons	100	300	400	300 to 400
" " trough, empty, tons	...	...	492	292.5
" " water in trough, tons	176	438	660	1,150
" " trough, loaded,** tons	289	879	1,161	1,442.5
Diameter of plunger	3 ft.	6 ft. 6¾ ins.	6 ft. 6¾ ins.	.....
Pressure on plunger, lbs. per sq. in.	530	442	469	.....
Excess of water to lower trough, ins.	6	16	12	3
" " " " " tons	17	98	64	35
Time of lift, mins.	2½	5 to 7	2½	2
" " lockage, mins.	8	20	15	15
Equiv. number of ordinary locks	6	5	..	5
Time by ordinary locks, hours	1 to 1½	2		½ to 1½
Cost of lifts and machinery	$147,200	$166,000	$163,000	.....
" total	$242,000	$341,000	$239,000	$300,000
" of operation per week	$75	...	...	...
Number of men	5	3	3	4

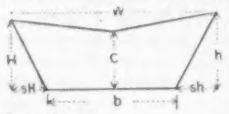
* There are four similar lifts on this canal, the only difference being that one of them has a lift of 63 ft. 7¾ ins.

** In the first three columns this includes the weight of the plunger.

LETTERS TO THE EDITOR.

EARTHWORK COMPUTATIONS.

Sir: The method given by Mr. Stout for earthwork computations in your issue of Feb. 21 does not appear to me to be the simplest that can be employed.



For three-level sections, one can easily obtain from the prismoidal formula:

$$\text{Vol. in cu. ft.} = \frac{L}{6}\Big[W_1 \left(C_1 + \frac{C_2}{2}\right) + W_2 \left(C_2 + \frac{C_1}{2}\right) + \frac{3b}{4} (H_1 + H_2 + h_1 + h_2)\Big]; \quad (A)$$

$$\text{and since } H_1 + H_2 + h_1 + h_2 = \frac{W_1 + W_2 - 2b}{s},$$

$$\text{Vol. in cu. ft.} = \frac{L}{6}\Big[W_1 \left(C_1 + \frac{C_2}{2}\right) + W_2 \left(C_2 + \frac{C_1}{2}\right) + \frac{3b}{4s} (W_1 + W_2 - 2b)\Big]. \quad (B)$$

When the slope is 1½ to 1, or $S = \frac{3}{2}$, formula B reduces to

$$\text{Vol. in cu. yds.} = \frac{L}{162}\Big[W_1 \left(C_1 + \frac{C_2}{2}\right) + W_2 \left(C_2 + \frac{C_1}{2}\right) + \frac{b}{2} (W_1 + W_2 - 2b)$$

Mr. Stout evidently prefers the form given by formula (A), but does unnecessary work in applying it. When $S = \frac{3}{2}$, I prefer the use of formula (C); and when S is $\frac{1}{4}$ or $\frac{1}{2}$, I think that time can be saved in making computations by the use of formula (B) in the place of formula (A), because W_1 and W_2 are in two terms of the formula, and these distances between slope stakes are all that we need to know about said stakes when applying the formula. Yours truly,

Geo. H. White.

Worcester, Mass., Feb. 23, 1895.

DISCUSION ON THE HALSTED ST. LIFT BRIDGE BEFORE THE AM. SOC. C. E.

Sir: My attention has been called to a point in Mr. Horace E. Horton's discussion of my paper on the Halsted St. lift bridge* that I overlooked in making my reply to the discussions. The reason for the omission is that the secretary of the society failed to send me a copy of the diagram that accompanied Mr. Horton's discussion, consequently I did not recognize the importance of the accusation. Had I received the diagram, I would certainly have answered Mr. Horton's objection in my resume, as I now beg permission to do in the columns of your paper.

In the first place, Mr. Horton's assumption of a play of 12 ins. in the screw is manifestly absurd, for the reason that the screw at present has only 14 ins. grip, so that if it were moved out 12 ins. there would be only 2 ins. of grip left. The adjusting detail was designed for a possible variation of only an inch or two, but is good for as much as 3 ins. on a pinch. In the second place, Mr. Horton's method of finding the horizontal movement is incorrect, because it is not a matter of rotation. The main piers rest on bedrock, consequently no sinking on their part is possible. Then the vertical columns resting thereon are anchored down to the masonry, and are held together at their tops by the overhead horizontal girders. If any adjustment of the screws be required, it will be caused by the settlement of the rear pedestals. That settlement multiplied by the secant of the angle of batter of rear columns will give the corresponding elongation of the screw. Or, if the elongation be assumed, its value multiplied by the cosine of the inclination will give the sinking, and the same value multiplied by the sine of the inclination will give the horizontal shifting of the foot. The tangent of the inclination or batter is 0.16327, for which the corresponding sine is 0.160, which, multiplied by an assumed elongation of 12 ins., gives 1.92 ins. for the horizontal shifting, instead of the 2⅞ ins. found by Mr. Horton. If we assume 3 ins. as the greatest allowable lengthening of the screw end, the corresponding horizontal shifting will be 0.48 in., while the sliding plates and slotted holes for anchor bolts in my detail permit of half an inch motion in each direction. Should this amount ever prove to be insufficient, which is highly improbable, the elongation of the holes can be easily increased by a small amount of work put on them with a cold chisel. It is evident, therefore, that the detail criticised by Mr. Horton has not the defect which he claims.

In the third place, a few minutes' computation will show that, even if we grant Mr. Horton's method of finding the horizontal motion to be right (which it is not), the gentleman was somewhat careless in his arithmetical calculations; because if we take the final difference in elevation of main and rear column feet at 48 ins., which his diagram scales, as nearly as may be, the horizontal sliding will be only 1 in. instead of the 2⅞ ins. which he finds. Very respectfully yours.

J. A. L. Waddell.

Kansas City, Mo., April 6, 1895.

* Trans. Am. Soc. C. E., Jan. 1895, p. 56. See also Eng. News, April 19, 1894.

AVAILABLE YIELD FROM PROPOSED DRAINAGE AREA OF THE JERSEY CITY WATER CO.

Sir: Of the two bidders for a new water supply for Jersey City, on March 25, the Jersey City Water Co. proposed to supply water from the drainage area shown on the accompanying map. This map is a true copy, in its proportions and outlines, of the topographical maps for this section published by the New Jersey Geological Survey. The square miles are indicated by the squares as delineated, so that any person can estimate the area of the watershed above the Beach Glen intake, the place proposed by the Jersey City Water Co.

The quality of the water in this area is beyond criticism. The quantity obtainable does not by any means comply with the requirements of the specifications, nor can Jersey City safely accept that source of supply because of the small quantity. The reservoir sites named are more than sufficient to conserve the flow from the watershed, but reservoirs are of no use unless supplied with water.

Allowing that all the flow of the watershed can be utilized, the estimate of quantity may be approximately found from the following data:

"The Highlands" (including this area) "are best represented by the record of Lake Hopatcong. Its average rainfall is 42.5 inches."*

A table of rainfall for 24 years at Hopatcong is found on p. 101 of Croes and Howell's Newark Report,** and the average is the same as stated by Prof. Cook, 42.5 ins.

The most liberal estimate of water collectable on this area is that of Croes and Howell, p. 101, estimated as 24 ins. over the entire area collectable annually, and Mr. Croes, as a witness before the Newark Aqueduct Board in 1889, estimated a much smaller proportion (about 14 ins.) as the proper basis of calculation on the Pequannock. The estimate of 24 ins. would amount to a total of 13,345,957,648 gallons, or at the rate of 36,564,240 gallons per day.

The ordinary estimate of engineers for the water collectable on the watersheds of northern New Jersey is at the rate of 1,000,000 gallons daily for each square mile. This estimate would give as the possible quantity obtainable from the proposed gathering grounds of the North Jersey Water Co., 32,000,000 gallons daily.

Another comparison, less favorable, can be made with the Pequannock watershed now utilized for Newark's supply. This is immediately adjoining the watershed now under our consideration, and subject to the same conditions in all essential features.

The New Jersey State Geological Report for 1892, pp. 249-50, describing the Newark system says:

> There has been a great deal of discussion as to the quantity of water available from the gathering grounds utilized by these works. Our investigations of rainfall and stream-flow indicate that we can at all times depend on collecting 14 ins. of the rainfall on the Pequannock, provided we have 7 ins. of storage for all portions of the watershed. The area tributary to the Macopin (Newark) intake is 63.7 sq. miles, and the above figures show that with storage for all portions of the shed equal to 7 ins. of rain, we can collect in the driest year 42,000,000 gallons daily. . . . . By careful management the watershed as now improved may be depended on for about 30,000,000 gallons daily in the driest year.

Additional storage to utilize the maximum capacity of the Newark watershed, the same report states, "will afford a continuous supply of 42,000,000 gallons daily." On the same basis of calculation for the upper Rockaway area of 32 sq. miles, the supply in the driest year would be 21,098,901 gallons daily.

The most liberal construction of the above official data differs so widely from the glowing representations of the Jersey City Water Co. as to cast doubt upon that company's promises. They claim that their "total watershed exceeds 47 sq. miles." By the accompanying map it is 32 sq. miles. They claim an "annual rainfall exceeding 48.63 ins." The actual record for 24 years shows it to be an average of 42.54 ins. They promise a supply of 50,000,000 gallons daily. It has been shown, above, that they cannot deliver, under the most favorable conditions possible, more than 36,500,000 gallons daily, and that a safe estimate for dry seasons is only 21,098,901 gallons daily.

But they promise an additional supply "through simple engineering devices" of 50,000,000 gallons more daily, or a total munificent quantity of 100,000,000 gallons daily when required.

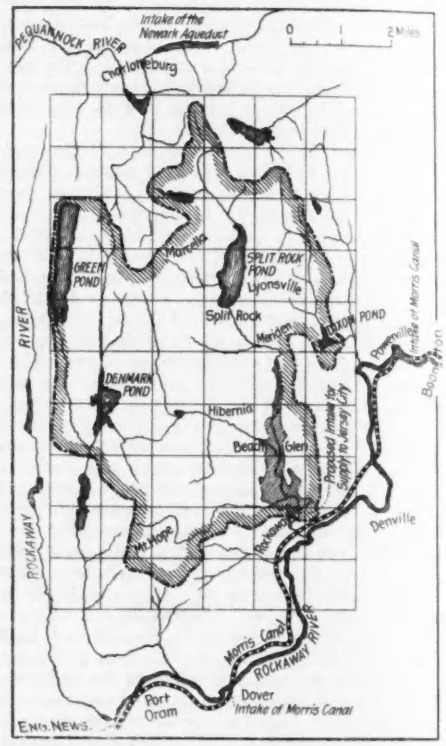
Referring again to the New Jersey Geological Report of 1892, p. 251, we find the estimated supplying capacity of the entire Rockaway watershed above Boonton to be 78,000,000 gallons daily. If the Jersey City Water Co. goes outside of its designated watershed for additional water, it must appropriate the Rockaway River itself, with all its filth; and when it has diverted the water of the whole region so that the river shall be completely dried up at and below Boonton, it must have recourse to the mysterious "simple engineering devices" to create 20,000,000 gallons daily of water that cannot be found in the Rockaway watershed, before it can fulfill its promise to provide 100,000,000 gallons daily.

New York, April 2, 1895. Contractor.

(Since the above letter was put in type the Jersey City Water Co. has publicly stated that its watershed is 34.78 sq. miles, instead of the 48 miles mentioned in its bid. Some 7 sq. miles of drainage area on Stony Brook, at the right of that shown on the map, is included in the scheme, and the intake dam, presumably, is located higher up than is indicated.

The communication from Mr. C. C. Vermeule, which appears below, also relates to the Rockaway River watershed. On the basis of Mr. Vermeule's figures for yield, the 35 sq. miles now claimed by the Jersey City Water Co. would give only 23,330,000 gallons a day. The Lake Hopatcong record, to which our correspondent refers, does show an average rainfall from 1846 to 1869, inclusive, of 42½ ins., but the minimum rainfall during that period was only 30.06 ins., of which Croes and Howell, on p. 101 of the report mentioned above, estimate that 14.84 ins. might have been made available for water supply purposes had proper storage been provided. This agrees closely with Mr. Vermeule's assumption of 14 ins., which latter gives a yield of about two-thirds of a million gallons per sq. mile of drainage area.

In accordance with our usual rule, a proof of the above letter was submitted to the Jersey City Water Co., and opportunity was given them to make a reply in this issue. The company declined to attempt a reply at present, however, on the ground of lack of time to consult with its engineers, and we therefore publish the letter, the matter being of current importance, and will give space to the company's reply in a later issue.—Ed.)



Map Showing Drainage Area Offered by the Jersey City Water Co. for the Supply of Jersey City, N. J.

ANOTHER PROPOSED WATER SUPPLY FOR JERSEY CITY.

Sir: The proposition of H. J. Reilly, the Carroll-Porter Boiler & Tank Co., and others, to supply water to Jersey City is briefly as follows: It sets forth that it is not, and from its nature cannot be, a bid under the specifications. It was submitted a little before the bids were opened under the advertisement, merely as an act of courtesy and fairness to those bidders. In all engineering and structural features it meets the requirements of Specification C, as advertised.

The source of supply is the Rockaway, above Powerville, and the gathering grounds embrace 118 sq. miles of highland country, well forested and with a small and decreasing population. Careful investigation covering several years has convinced us that during dry periods only 14 ins. of rainfall annually can be collected upon the Passaic headwaters. This is practically two-thirds of a million gallons daily for each sq. mile. Our available supply is 78,000,000 gallons daily at this point, and we maintain that Jersey City should pre-empt and occupy at least this much and protect it for future use. We estimate that the first year after turning on the new supply the city will require 30,000,000 gallons daily and 15 years thereafter 50,000,000 gallons. Possible sales to neighboring communities may greatly increase these figures. The only possible sources of contamination of this watershed are the villages of Dover and Rockaway. An intercepting sewer will provide for this, diverting all sewage to a point without the watershed. Storage reservoirs are planned to furnish ultimately the equivalent of 7 ins. of rainfall for every part of the catchment. Of these we offer to build enough to provide 5,000,000,000 gallons capacity at once. The intake reservoir is on the main stream at Powerville, at 505 ft. elevation above mean tide. Delivery will be by a conduit 132,000 ft. long, with a tunnel through Orange Mountain 2,750 ft. long, and 6 ft. internal diameter, lined with brick, and of horseshoe section. Above the tunnel the conduit will consist of two steel pipes of 40 ins. effective diameter, hydraulic slope 1.6 per 1,000. From the tunnel to Jersey City it will be of two steel pipes of 36 ins. effective diameter, hydraulic slope 2.7 per 1,000. River crossings will be by 36-in. cast iron flexible-joint pipe on the bed of the river. Delivery in Jersey City will be at a pressure equal to a head of 210 ft. above tide. At three points on the conduit line there will be open waste overflows, preventing undue pressure. The pressure will be only what is due to the height of the hydraulic grade line.

The points kept in view in the plans are: (1) Occupation of a very desirable and sufficiently large gathering ground to allow for increased consumption, but not so much as to be evidently far beyond the needs of the city or its ability to protect the same from pollution or diversion; (2) the value of a good pressure in increasing the range of possible consumers of water; (3) the protection of a double conduit in case of breakage, since the capacity of the city reservoirs is and must be limited.

Under New Jersey laws authority to divert water is gained only through right of eminent domain granted for that purpose, consequently these parties appear only as contractors and agree to pay costs of condemnation and construct the works complete within two years from the date of contract for the sum of $7,500,000, of which two-thirds is to be paid in city 4% bonds from time to time during construction, on engineer's warrants, the remaining $2,500,000 to be provided for by the construction company's 5% bonds trusteed by the city, which will pay the interest thereon, and may at any time after completion of the works substitute for them city 4% bonds at par and own the works. As the construction company gives a bond for $500,000 besides, the city will be secured to the extent of $3,000,000 until the works are accepted. Respectfully yours,

C. C. Vermeule, Chief Engineer.

New York, April 9, 1895.

(The proposed supply described above contemplates using the whole drainage area of the Rockaway River above Powerville, and thus includes the lakes and streams from which the Jersey City Water Co. intends to draw water if it receives the contract. The bid of this company, which was one of the two accepted as formal on March 25, 1895, was given in detail in our issue of March 28.—Ed.)

PROPER RELATION OF ELASTIC LIMIT TO ULTIMATE STRENGTH IN STRUCTURAL STEEL.

Sir: In your issue of Feb. 28, in an article on "Tests of Steel for Bridges," you state that:

> It has frequently been claimed by structural steel makers that in drawing specifications the elastic limit should not be specified to exceed half the ultimate strength, and that at least 10,000 lbs. variation should be allowed between maximum and minimum limits of ultimate strength. Some recent tests, however, have shown that there is no difficulty in procuring steel with an elastic limit equal to two-thirds the ultimate strength, and that a difference of 7,000 lbs. between the specification limits for ultimate strength can be met without difficulty.

If this is the case, I would like to ask why the American Engineering and Inspecting Association did not adhere to these requirements in their specifications for structural steel just issued? Their specifications are very complete in every detail, and were made after these gentlemen had inspected several thousand tons of steel under the specifications of Mr. Geo. H. Thomson, with the above requirements. But instead of doing this, they call for an elastic limit of only one-half the ultimate strength, and give a difference of 10,000 lbs. between the specification limits for ultimate strength, and by so doing have shown that their extensive experience confirms the position taken by some of the manufacturers.

The specifications of the American Engineering and Inspecting Association on these points, and their notes on same* read as follows:

	Minimum and maximum ultimate strength.
Very soft steel	50,000 lbs. and under
Soft "	50,000 to 60,000
Soft medium "	55,000 " 65,000
Medium "	60,000 " 70,000
Medium hard "	65,000 to 75,000
Hard "	70,000 " 80,000
Very hard "	80,000 and over

Elastic Limit.—All grades of steel shall have a minimum elastic limit of one-half the ultimate strength.

The physical requirements in these specifications are purposely made more moderate than in many others. The possibilities of steel making are well known, and it is useless to make specifications outside of them. Very high specified limits for physical tests do not always bring any better steel, but only make it necessary to carefully select the places from which the test pieces are cut, in order to get the desired results. Sometimes, especially if these limits are not well "balanced" among themselves, they are a temptation to the manufacturer to put special treatment on the test pieces. They lead the purchaser, too, to a false sense of security in his structure, giving him the idea that the whole of the metal is of the character which the steel maker sometimes knows is only possessed by selected or possibly specially treated test pieces. It is believed to be better to specify such physical limits as the poorest part of a piece of steel should show, and which can be obtained without undue expense or extraordinary manipulation by any skillful maker. And this, of course, carries the inference that the purchaser or his inspector possesses sufficient knowledge of steel making to select his samples for testing from the places which will give the poorest results. The strength of a structure, like that of a chain, is the strength of its weakest link; and there would seem to be little use in making experiments on the strongest links, while we do not know what the weakest one will bear. Some specifications are in use wherein the limits are so fixed that it is absolutely necessary to carefully select the best places in order to get results fulfilling the requirements, because steel cannot be made whose worse parts will satisfy the conditions.

To those who are entirely unacquainted with the use of steel the question may arise, inasmuch as the working stress on a structure is always designed to be considerably less than the elastic limit (so called) of the material, Why not use the harder grades of steel, having a high elastic limit, with a correspondingly high unit stress, and thus effect a considerable economy in weight? If it is safe to impose a unit stress of 10,000 lbs. per square inch on a material whose elastic limit is, say, 25,000 lbs. per square inch, why is it not equally safe and much more economical to use a unit stress of say 25,000 lbs. and a material whose elastic limit is known to be not less than 40,000 lbs. per square inch. The reason is because the harder grades of steel have a less extensibility beyond the elastic limit than the softer ones. Although the maximum stress on a member is always designed to be well within the elastic limit, probably no piece of metal which ever enters into a structure is not strained beyond this limit in some portion. The process of straightening, for instance, puts a "permanent set" in some portions of the bar, otherwise it would not be straightened, while punching and shearing always strain the metal beyond the elastic limit, in the immediate vicinity of the parts operated upon. Now, in the softer grades of steel, such local deformation beyond the elastic limit can be made without serious injury to the bar as a whole; but with the harder grades, by reason of their less extensibility beyond the elastic limit, it is liable to produce fractures.

The ultimate strength of steel depends fundamentally upon the percentage of elements contained—the principal hardener being carbon. With these as a base, the ultimate strength may be increased or diminished from normal conditions by varying the heat treatment and manner and amount of work. The specifying of narrow limits for ultimate strength, in order to secure a uniform steel, may therefore result in securing a metal that is decidedly non-uniform in other respects.

The elastic limit herein provided for of one-half the ultimate strength is a safe minimum limit for all kinds, grades and qualities of well-worked steel. In steel castings, which are not worked at all, and in large sections which only receive work enough to bring them to form, the elastic limit will sometimes be found to be somewhat less than one-half the ultimate strength.

Elastic limits, as ordinarily determined in testing machines, are in reality the "breaking down" point of the test specimens, and are beyond the point of true elastic limit. The elastic limit is reached when a material receives sufficient stress to distort it beyond recovery to its original form. There may be several such points in steel, and some investigators claim that every stress, however slight, produces a "permanent set" in steel. When steel has received a sufficient stress to destroy all of its elasticity, so that each additional increment of stress which is applied, whether great or small, increases the distortion, the final elastic limit has been passed, and the material is no longer fit for use.

Some of the manufacturers of structural steel refused to bid on a material with following requirements:

Ultimate strength, lbs. per sq. in.....56,000 to 63,000
Elastic limit, lbs. per sq. in., not less than.....38,000
Per cent. of elongation in 8 ins., not less than.....20
Per cent. of reduction of area " " " 50

For some makes these requirements were modified. In view of these facts, your statement that such material can be obtained without difficulty is rather misleading.

The American Engineering and Inspecting Association have evidently reported as the elastic limit what they consider the yield point in the tests referred to in your issue of Feb. 28, and I would ask if they will kindly give, through your columns, their views as to what the true elastic limit is of this material. In other words, if the elongation had been taken by electrical contact for each increase of 1,000 lbs. per sq. in., would the elastic limit obtained by this method have been 50, 55, 60 or 65% of the ultimate strength. By answering this fully, and giving any other information on the above, they will greatly oblige the writer. Yours respectfully,

Wm. R. Webster.

3310 Hamilton St., Philadelphia, April 4, 1895.

(In accordance with Mr. Webster's request, a proof of his communication was sent to the American Engineering and Inspection Association, 51 State St., Albany, N. Y. Replies have been received from Mr. A. C. Cunningham, M. Am. Soc. C. E., in charge of the Eastern Pennsylvania office of the association, at Wayne, Pa, and from Mr. Chas. C. Stowell, M. Am. Soc. C. E., of Albany. Mr. Cunningham's letter is given first and is followed by that of Mr. Stowell.—Ed.)

Sir: In reply to Mr. Webster's letter allow me to state that in inspecting steel for our principals, we do not substitute our specifications for theirs, but work to the specification under which the contract was made. When the steel we are inspecting does not comply with the specifications under which it is made, we reject it, unless the case is worthy of further consideration, when we refer the matter to the engineer.

Our specification was issued in the hope that it might diffuse some general knowledge on the subject of steel amongst those who have not had the opportunity to become personally familiar with mill practices, and that it might tend to promote a better understanding between the user and the manufacturer. There are, unquestionably, better specifications than ours; possibly there are some that are worse.

The term "elastic limit," unless qualified, is a trade nomenclature meaning the drop of the scale beam in the testing machine. The term had this meaning when I inherited it from my predecessors, and will probably retain it when I and my contemporaries have passed the "yield point."

This scale beam "elastic limit" is of quite as much, if not more, importance than any other elastic limit. We know that there is a point somewhat below this that to the analytical mind seems more worthy of the name, and as long as opinions differ, we shall never lack a topic for a warm scientific discussion on this subject.

When a structure has been loaded to the true elastic limit of the material, it fails. Before we can know that it has failed it must pass the scale beam elastic limit, when, from the stretching of the material and the sagging of the structure, we know very well what has happened.

Right here is the reason why soft steel is generally preferable to hard for structures. After hard steel has passed the scale beam elastic limit, it gives way with little additional stretch, while soft steel stretches considerably before rupture, and thus may give ample warning of danger.

I have a case in mind in which a mill was caused considerable trouble by a specification that contained a maximum as well as a minimum elastic limit. It was found almost impossible to keep the elastic limit below the maximum in ordinary sections, and as the manufacturers were "straight people" they had the matter adjusted before going further with the manufacture.

Mr. Webster evidently considers that we are inconsistent about "elastic limit," and I will therefore give him my opinion on the subject, as follows:

An engineer has a right to specify an elastic limit as high as he chooses. If it is not too high the manufacturer will get it by using the proper kind of steel and giving attention to its analysis, heat treatment and working—if he knows how. If he doesn't know, he will criticise the engineer severely.

* See Eng. News, Feb. 14, 1895.

If the elastic limit has been specified too high, the experienced and honest manufacturer will say so; and by this I do not mean that well-developed desire to have specifications so made that the very poorest of material will find it impossible to get outside of them.

When a high elastic limit has been specified, it will not be reached in heavy sections, as pins and thick eye-bars, but the engineer knows this, or will, if he has a capable inspector; and he also knows that in the average sections which constitute the larger percentage of his structure, he will have it, if the material is honestly and intelligently made.

Should an engineer not desire a special steel, or a specially-treated material, he may specify a moderate or low elastic limit; by so doing, however, he decidedly widens the competition.

When an engineer uses the term "elastic limit" in a specification without qualification, it is generally meant and accepted that he means the scale beam elastic limit.

I have a great deal of respect for the delicate and complicated mechanisms that are often attached to tests and testing machines, but I can see no reason why they should be made a fulcrum to overturn commonsense, because they definitely locate a point, the general position of which we already know.

Very truly yours, A. C. Cunningham.
of the Am. Engr. and Ins. Assoc.

Wayne, Pa., April 13, 1895.

(Mr. Stowell's letter is as follows:—Ed.)

Sir: I have received from you proof of a letter from Mr. Wm. R. Webster to which he asks a reply through your columns from the firm of which I am a member. The gist of this letter is, as I understand it, as follows:

(1) A short article was published in your columns on Feb. 28 last (and in other technical papers of about that date) calling attention to the unusually high percentage of elastic limit to ultimate strength, and to some other peculiarities shown by a lot of tests made on structural steel by the firm of which I am a member, and in this article the statement is made that there is no difficulty in getting steel whose elastic limit is two-thirds the ultimate strength, or in getting an ultimate strength within 7,000 lbs. per. sq. in. limit of variation.

(2) Our firm has inspected a considerable quantity of steel, made under Mr. G. H. Thomson's specifications.

(3) A specification has recently been published by us in which the elastic limit is fixed at one-half the ultimate strength and the limit of variation in ultimate strength fixed at 10,000 lbs.

From these facts, Mr. Webster apparently infers that after a considerable experience with Mr. Thomson's specifications we consider them too rigid, and have set up something easier instead. Likewise, that we are inconsistent or vacillating in giving our opinion about elastic limit and ultimate strength at one time, then incorporating different ideas in our specifications.

The article on tests referred to was not written by us, and no one connected with our firm had any knowledge of it until it appeared in print. We had no more to do with the opinions in that article than Mr. Webster had, but this I will say, that the results commented on in that article were obtained without any particular "fuss" or trouble, and I have no doubt could be duplicated as many times as wanted for the kind, quality and grade of steel specified and made.

Mr. Webster should not conclude that because we have not copied Mr. Thomson's specifications we repudiate them. He does not seem to appreciate that those specifications were written to cover a particular kind, grade and quality of steel, while ours are absolutely general. If I was specifying a particular kind, grade and quality of steel for a particular use, it is conceivable that I might use different requirements from those intended to cover every kind, every grade and every quality in general use. By carefully reading the "notes" which Mr. Webster has so liberally reproduced, he will find that we consider 50% of the ultimate strength a "safe minimum limit for all kinds, grades and qualities." For steel corresponding to that called for by Mr. Thomson's specifications, we would in all probability get results equally as good as his, and far above the minimum limit for any steel.

Mr. Webster has asked "some of the manufacturers" for prices on steel of certain properties, and did not get them; hence he pronounces our statement misleading. Though we did not make the statement to which he refers, I will say this, that our firm is now inspecting steel at four different mills which would easily fill his requirements, and how many more there may be I do not know. So it does not seem to be very hard to get. But to get it, you have to go where it is made. If Mr. Webster wanted to get some Basic-Bessemer or Clapp-Griffiths steel, he might ask a very large majority of the manufacturers for it without success, but still I do not think he would consider them hard to get.

Even if Mr. Webster had gotten the steel he asked for, and it fulfilled all of his requirements, it might still have been poor and unreliable metal. Without knowing the kind and quality of steel, as well as its physical characteristics, one can really judge very little of its suitability for his use. He may get the most satisfactory of physical tests on small specimens, but unless he knows more than this he can have no assurance that the rest of his steel is equally as good as the speciments tested, and can really know very little about it.

The elastic limit referred to by Mr. Webster has the meaning ordinarily ascribed to it in everyday practice. It was measured by the drop of the beam in the testing machine, as in all ordinary tests. The subject of elastic limit is referred to and briefly explained in the "notes" which Mr. Webster so liberally quotes (See Eng. News, Feb. 14).

In answer to his question as to what the elastic limit would have been if it had been determined in some other manner, I regret to say that I do not know.

Yours truly, Chas. E. Stowell,
of the Am. Eng. and Insp. Asso.

Albany, N.Y., April 11, 1895.

NOTES AND QUERIES.

A "Subscriber" asks: (1) "What elevation is required on the turns of a racing track for trotting horses, going at the rate of a mile in 2:16 and drawing the bicycle sulky, on a radius of 210 ft. for the inside of the curve? According to old rules a rise of one foot in ten feet would answer for this radius; but the bicycle sulky does not require so great an elevation?" (2) "What elevation is required on the curves and approaches of a bicycle track with straight sides 381.54 ft. long, joined by a compound curve at the ends? The radii of the compound curves are 420 ft. for 43.98 ft., 140 ft. for 410.50 and 420 ft. for 43.98 ft. The speed is to be as fast as possible?" We trust that some of our readers who have had experience in laying out race tracks will answer our correspondent's questions.

GAS AND OIL ENGINES AND THEIR PROSPECTS.

At the April "Engineering Evening" of the American Society of Mechanical Engineers, held on April 10 at the Society's house, the subject of discussion was the "Present Status of the Gas Engine." The Chairman, Mr. Emerson McMillin, in calling the members to order, said that the gas engine is a piece of mechanism that has been very greatly underrated. The load of very heavy royalties to German inventors and the high manufacturers' prices and indifference of gas engineers and parsimony of gas companies had combined to retard its extensive introduction.

Mr. Sidney Armor Reeve, of the "Progressive Age," in opening the discussion, laid principal stress on the idea that gas power was superior to steam power, because of the economy with which it can be distributed. He considered that for an industrial plant using a large amount of power and covering a large area, a power plant, consisting of a central boiler plant distributing steam to separate steam engines for each department, was in general superior to a plant in which power from a single mammoth steam engine was distributed over a considerable area by shafting and belting. In many cases distribution by electricity had proved superior to steam distribution. Mr. Reeve considered, however, that in any such plant the gas engine promised to become the motor of the future. He would substitute for the central boiler plant a gas producer and storage holder, and would have lines of gas pipes leading to gas engines located in each department. The first cost of such a system should be far below that of any system, except, perhaps, the subdivided steam power system. In economy of operation the gas plant has a great advantage, according to Mr. Reeve, as follows:

In the steam subdivided plant, no matter how large a proportion of the load be off, the central generating plant must be run, and the fixed charges of running cannot be altered. Steam must be kept up, the boilers must be kept hot, the stack (if there be one) must be kept hot, and the labor must be there to take care of the whole matter. I have myself tested one factory in which, for a large proportion of each day, the efficiency for the transmission of the power between the boiler plant and the work was 5%, simply because they had to keep the whole plant going in order to move one small department. With the gas plant that entirely disappears. Your gas generator works for a certain number of hours a day on maximum economy, and, as we all know, there is only one point in capacity in which any apparatus can work at maximum economy. During those certain number of hours a day the generator makes gas whatever load or capacity is best suited to produce and stores it in the holder. The gas generating plant is entirely unconscious of the consumption of power, provided it be large enough to fulfil all demands. The consumers of power—the foremen of different departments—are as unconscious as is the generating plant of the consumption of power. They simply know that all they have to do is to turn on their gas and start their engine. They may run 24 hours in a day, while the gas generator runs 8, provided the total maximum production of the gas generator is large enough to cover the whole output of power.

A further advantage of gas for power is that gas is the fuel best adapted for a variety of metallurgical works, glass works, potteries, etc. And in all such establishments it is as natural that the gas engine should ultimately survive as that in the New England textile mills, where steam is used for such a variety of purposes, the steam engine should supplant other forms of motors. In closing, Mr. Reeve said:

On the other hand, it is true that the gas engine today, after having had spent on it the best energy in the line of mechanical engineering which the world has been able to produce for some 30 years, is still more crude in a great many mechanical features than was the steam engine of a century ago. It is still very heavy. In nearly all of the devices only one impulse is received by the flywheels for every two revolutions; in the case of the single-acting engines only one is received; so that the flywheels are heavy. The regulation, as a rule, is accomplished by simply dropping out a certain proportion of the impulses instead of varying their strength; and the necessity for the ignition of the charge in a minute fraction of a second has led, until very recently, to extreme uncertainty in the matter of ignition, and also in the question of perfection of combustion. That last is not so marked a feature, because even with poor combustion the gas engine is an exceedingly economical prime mover. But the mechanical difficulties still stand in the way of the accession of the gas engine to the proper field in which it belongs; that is the universal factor for the production and transmission and subdivision of power in industrial works.

At the risk of being considered rather superficial in skimming over this subject, I will take one step into the future and say that while gas engines have hitherto been almost entirely run with illuminating gas, yet already there has been considerable done in the way of supplying gas engines with special producer gas from special producers built just for that purpose. There has also come upon the field—I will just mention it—the incandescent gas burner; that is, it has just begun to attract wide attention as being an established fact. These two coupled together—first, that the gas engine can be run much more economically upon producer gas, not illuminating gas, than it can upon illuminating gas; and second, that there is a means attained of producing illumination by a non-luminous gas—lead us to the hypothesis that the near future will see the distribution of all energy—which is derived from coal, in the form of a non-luminous, cheaply produced fuel gas; that this gas will be relied on entirely for power and for lighting, where gas lighting at all is permissible, and where it is not, where the electric light is needed, that electric light will be produced through the medium of gas engines, and further, that this same gas will be used for all domestic heating and cooking and industrial heating of all sorts.

Mr. Anson W. Burchard, M. Am. Soc. M. E., of Danbury, Conn., then read a paper describing experience with three 100-HP. Otto gas engines in service in an electric lighting station at Danbury, Conn. Publication of this paper, with that part of the discussion relating to it, we defer to a later issue.

Prof. Wm. L. Aldrich, of the University of West Virginia, sent a written discussion, of which the following is the substance:

Some of the chief difficulties to the extended introduction of the gas engine have been gradually removed by the improvements in methods and apparatus for the manufacture of producer gas, on a small yet economical scale. For the distribution of power from a central plant to greater or less distances, gas offers peculiar advantages. There are practically no losses in distributing the gas in pipe lines, except leakages, which can effect the economy of the distribution. Losses of pressure and temperature changes do not in the least affect the economy of the gas engine at the end of the line. Therefore the distribution of power by gas and its utilization in gas engines scattered over a widely-extended area may come to be a rival of some of the other methods. And the facility of storage and use of gas for heating are additional advantages.

It seemed doubtful for a long time whether gas engines could be made and economically managed in large units; but the present use of the same up to 300 HP. and the contemplated manufacture of gas engines of 500 HP. and upwards, leave no room for serious doubting. But it is open to discussion whether there is the same inherent gain in economy in the use of large gas engines as in the case of steam engines. Of course, on the general principles of power production, large units are more economical per horse power than small units. Nevertheless, there is scarcely an argument advanced for the use of large steam engines that can be similarly advanced in the case of gas engines.

In matter of speed regulation gas engines have had an unenviable reputation, more due to the inherent difficulties of control than to any lack of inventive ability along this line. Always single acting, frequently run at slow speeds, and sometimes with rapidly-varying loads, it is not difficult to understand that during one or more strokes the supply of gas may be entirely omitted, and the unusually heavy fly-

wheel drawn upon to meet the periodic variations in the supply of energy.

Respecting the conditions of maximum economy in the use of gas, it has been found that there is a certain best load, for any given engine running at a given speed, at which load there is the least expenditure of gas per horse power per hour. In this way it is possible to establish a very satisfactory basis for rating gas engines; that is, by their most economical performance. If gas engines could be tested and the curves of performance plotted as in the case of turbines sent to the Holyoke Testing Flume, the whole gas engine business would at once be placed on as satisfactory and substantial a basis as is now the case with turbines. The establishment of such a gas engine testing plant is urgently needed. It would go far towards giving much-needed additional encouragement to well-directed efforts in the development of the gas engine, as well as serve to forestall fruitless attempts in the same line.

Mr. George Richmond, Consulting Engineer of the De La Vergne Refrigerating Machine Co., said that the company some time ago desired a motor for operating small refrigerating machines, and investigated the gas-engine question. He collected catalogues from some 30 different manufacturers, and found that while their list prices represented an enormous profit upon the actual cost of making, they were ready to offer heavy discounts to purchasers. During the past summer he had investigated the gas-engine business in Europe, and had found that there the gas engine appears to be a back number for anything smaller than 50 HP., and the oil engine has taken its place. Before the oil engines came in abroad, the gasoline engine had a season of popularity; but the risk in connection with the use of gasoline has caused it to be discarded there. In the United States the gasoline engine has very largely supplanted the gas engine, and though foreign owners of oil engine patents have made every endeavor to introduce oil engines here, they have not made much headway. The reason appears to be that the first cost of a gasoline engine is about half that of an oil engine; and in this country the insurance authorities have consented to the use of gasoline. Mr. Richmond then introduced Mr. W. Lawrence Wildy, representing Hornsby & Sons, of Grantham, England, makers of oil engines, who spoke in substance as follows:

Most of you know, doubtless, that the gas producer is an ordinary cylindrical vessel lined with fire brick, and more or ,ess intricate in shape according to the inventor's idea of what his patent is, and with certain cooling surfaces or heating surfaces or conducting surfaces. But the simplest producer I have ever used was a column of fuel about 10 ft. high. The fuel we used in England was coke—the coke which after the distillation of the gaseous product was a residue, and this went to make the cost of the production of gas a mere cipher to the corporation running that gas concern. In Leeds, where I had my experience principally, the gas which was distributed through the houses cost nothing in the holder—it was all profit. I have seen the figures and I have gone into it with the chairman of the gas committee of the Leeds corporation, and it is a fact that it was a decimal short of nothing in the holder. The by-products from making the bituminous gas were so valuable at that time that they paid all the expense, interest and depreciation of plant, and the gas in the holder cost nothing but distribution and collection of accounts. Thus we got gas supplied for 21 cts. per M. and 5% discount for cash on quarterly account. But at this time we were using enormous quantities of gas in our works for welding steel tubes, from 20 ins. to 60 ins. diameter, and 5-16 to ¾ in. thick. Thus our gas bill ran from £6,000 to £7,000 a year. As this was a pretty heavy item, we put in a water-gas plant, and made our own gas, at a cost of a little over £1,000 a year for fuel, interest, depreciation, labor and all. That gas cost us on an average about 7 cts. per 1,000 cu. ft.

In the oil engine we have a machine which works with the ordinary petroleum of commerce—that is, any of the lighting oils which are on the market. It will also work with the heavier oils up to the specific gravity of .9 and a flash point up to 320° Fahrenheit. The process through which this oil goes to produce its power is as follows: The engine is provided at the back of the cylinder with a small cylindrical chamber, which we call the vaporizer. On this vaporizer is fixed a valve chamber, which really holds two valves, and which are the governor valves of the engine; the one opens inward to the vaporizer, the other opens by the action of the governor outward, and through a small pipe conveys any oil which is not required back into the tank from which the pump has drawn it. The rest of the construction of the engine, so far as its communicating the power imparted to it is concerned, is almost identical with the gas engine. The engine operates a small oil pump, having a stroke which can be adjusted so that the amount of oil which is injected into the vaporizer is exactly in proportion to the power the engine requires. In operating the engine you begin by heating the vaporizer with an ordinary paraffine lamp with a circular wick, to which a small fan is attached, producing for the time being a little petroleum forge. It takes five to ten minutes to heat the vaporizer. As soon as it is hot enough a cock on the cylinder is opened, and you can turn your flywheel, and your engine goes off at full power. The governing is brought about by the distension of the governor balls acting on a lever, which depresses the second valve in the little valve chamber on the vaporizer, so that the oil which is pumped up and which is in constant supply is not allowed to enter the vaporizer. Immediately on starting, the lamp goes out. That is to say, the lamp, if properly filled, will run just long enough to heat the vaporizer to the right temperature, and will be burned out at that time. In England, when our experts go out to teach anybody there to start engines, they say to the man: "You just work that handle gently until that lamp goes out." Thus, when the engine is in motion, we have no lamp, we have no tube, we have no electricity, but the continual combustion of the oil in the vaporizer restores to the vaporizer the heat which has been extracted by the vaporization of the oil and the heating of the air necessary to produce the subsequent explosion. These engines have been running continuously day and night without stopping, without any hitch whatever, and the higher the work that is taken out of the engine, up to full power, the better the engine works. At very low powers the engine will want a little nursing perhaps, but at full power she will work right along. We start our engine at 5:30 in the morning, and the men come in at 6 a. m.,, and she is never looked at again except when the man goes in at dinner time and oils her, and at 5:30, when he goes to stop her; and there is no outside flame, no exposed red heat or dangerous flame of any sort about the engine.

There is no residuum in the cylinder, and the consumption runs about ⅞ of a pint of American Daylight or water white oil per HP. on all sizes of engines. It runs a little lower, but only a little lower, on the larger engines than on the smaller ones. The very little ones will use a pint. They have a slightly greater loss, owing to the friction of the engine itself. These figures are per brake horse power, not indicated horse power. We sell the engine on the power which the purchaser is going to get off the flywheel. He doesn't care what the power is in the cylinder.

In Russia they are adopting these engines so fast that we cannot keep pace with the orders. With us in England it is a matter for consideration, because the oil, which I understand you give about 7 cts. a gallon for, costs us about 13 cts. a gallon. Nevertheless, they are doing wonderfully well with the engines over there. Every class of power user is adopting them to the rejection of all steam engines up to 50 or 60 HP. They are put in the hands of stablemen, gardeners, coachmen, all sorts of people, who, after they are once instructed, know what to do.

With gas at 50 cts. per M. ft. and oil at 13 cts. per gallon, an oil engine will run at less cost than a gas engine. The gas engine makers will tell you that they use 14, 16, 18 cu. ft. per HP. As a matter of fact, they will use 25 to 30 in regular work. With the producer gas you will use at the very least 90 to 100 cu. ft. of gas, and then you have always to provide an attendant to the producer and the steam boiler, and you have got a great deal more plant to put down for that gas engine than the oil engine. When you come to take into consideration the depreciation on the first cost and the labor, you get a cheaper engine with the oil engine than with the producer gas engine.

Mr. Paul Winand, Superintendent of the Otto Gas Engine Works, Philadelphia, contributed the following written discussion at the close of the meeting:

Concerning gas lighting by incandescent burners, I know by actual experiment that the temperature obtained from producer gas is not sufficient for the purpose. On account of the large percentage of inert gases which it necessarily contains, it is not even economical to enrich it for lighting purposes. However, by reason of the cheapness of the power obtained from this gas, electric lighting is generally the best possible way of providing light in such an installation. Pure water gas, though it can well be used in incandescent burners, is more expensive per heat unit, and on the whole cannot compete with producer gas.

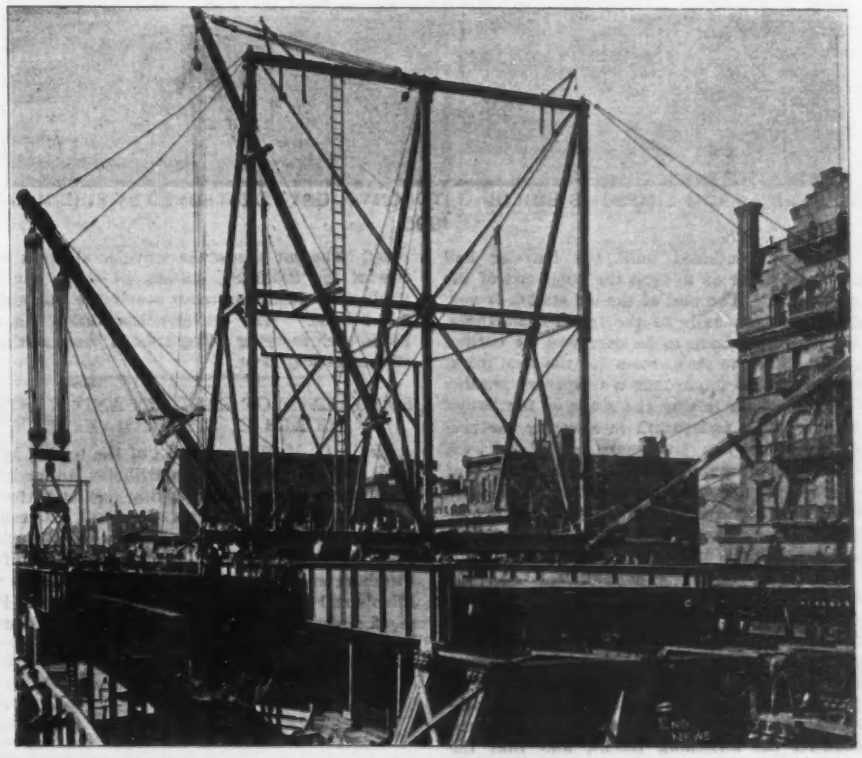
It is generally thought that by increasing the number of impulses the gas engine can be greatly improved, as far as regularity of motion is concerned. This is only an argument of relative value, however, as the question resolves itself to this: Whatever the number of impulses may be, there must be flywheels of sufficient momentum to produce the desired degree of regularity. Now, is it cheaper, more economical and generally preferable to have a simple engine with a large amount of momentum or a more complicated one with smaller flywheels? The same regularity can be obtained in all cases, and it has not been proved that a simple engine of sufficiently high speed is not the more preferable solution. A considerable experience in this line has shown to me that it would be decidedly wrong to complicate the construction in order to get more than one impulse for each revolution. I should wish to emphasize the point made relative to the use of fuel gas for industrial heating purposes concurrently with its use for power. The advantages of gaseous fuel when applied not only on a large scale, as for metallurgical operations, but in smaller apparatus of various kinds, are being gradually recognized.

Mr. Richmond has stated that oil engines were not made in this country, that they were, in fact, hardly known. Such engines have, however, been manufactured here for several years, and considerable efforts have been made for their introduction. We ourselves are fully prepared to begin their manufacture if a sufficient demand should arise. But in view of the fact that gasoline engines are so much preferable in most every respect, it is not surprising that the demand for oil engines should be so small. Gasoline engines have all the advantages of gas engines, and in some of those built in this country to-day the provisions for safety are so absolute that the insurance companies have no objection to their use. Besides the objectionable smell which seems inseparable from the oil engine, there is the objection of its not being ready for starting at a moment's notice. Oil engines are naturally wasteful when running at partial and variable load. This is due to the fact that the proper degree of temperature is not maintained at the different loads which occur in practice. When a continuous external flame is used for maintaining this temperature the fuel consumed in this flame decreases the efficiency at reduced loads.

The oil engine described by Mr. Wildy was exhibited at the World's Fair. In this engine the ignition of the charge depends on the temperature of the chamber which is left uncooled at the rear. The temperature of this chamber, and consequently the time of ignition, vary with the load, and this circumstance produces an additional variation of the efficiency with the load. Oil engines are naturally somewhat more complicated, more expensive and less convenient than gasoline engines, and unless there be a marked difference in the prices of the two fuels the latter would seem preferable in most cases.

REBUILDING RAILWAY WORKS WITHOUT STOPPING TRAFFIC.

The difficulties encountered in engineering work and the ingenuity required in carrying it out are greatly increased where the work has to be done in the midst of traffic which must not be interfered with by the prosecution of the work. An interesting example of this is the reconstruction of the New



TRAVELER FOR ERECTING THF PARK AVE. VIADUCT FOR THE NEW YORK CENTRAL R. R. NEW YORK CITY.

York station of the Brooklyn Bridge, now in progress. The present station includes two tracks and two platforms, separated by the depressed way for the promenade. The new station, which was described and illustrated in our issue of Nov. 8, 1894, will cover the same site, but will be longer and wider, and will have four tracks and two island platforms, while the grade of the tracks will be raised and that of the promenade will be lowered. When it is remembered that trains are run all through the 24 hours (with a minimum headway of 1½ minutes and a maximum headway of 15 minutes), that provision must be made for the accommodation and safety of the great crowds which throng the platforms during the busy hours, and that there is a continual traffic on the promenade, it will be seen that great care must be exercised in carrying on the work. The first step was to cut into the roadways and set the two plate girders carrying the columns at the outer end of the station (which will be longer than the present station), and then to build a short section of the new masonry foundation and erect the first panel of the ironwork up to the level of the floor for the new track. Rails were then laid on this floor, upon which were mounted the trucks for the traveler and the towers of the traveler were then erected and connected by a truss spanning the existing tracks and the promenade. Erection was then continued, completing the structure for the new tracks and putting up the columns and framework for the exterior walls of the station,

STEEL BEAMS FROM SIMPSON'S BUILDING, TORONTO, ONT., DESTROYED BY FIRE MARCH 2, 1895.

and this was continued until the traveler had worked back so far as to meet the outer end of the present station. The roof of the old station is now being removed gradually as the traveler advances, and the platforms have to be narrowed by cutting away at the back to make room for the new work. Over a part of the promenade a temporary wooden floor has been built raising the grade so that work can be carried on underneath in lowering the permanent grade, the new promenade being level with the roadways. Perhaps the most difficult part of the work will be the rearranging of the tracks, and temporary trestling and platforms will probably be required at that stage of the proceedings. The entire proceedings are of considerable interest and well repay examination. At the Brooklyn station, which is now nearly completed, and which we shall describe and illustrate in an early issue, no such difficulties were encountered, as the site is beyond that of the present station, and the tracks are on the original grade, so that the station could be practically completed without special methods, except that the work must not obstruct the switching tracks, and that the north end cannot be completed until part of the old station is removed.

Another case of a somewhat similar kind, though more easily carried out without interfering with the traffic, is the erection of the four-track steel viaduct for the New York Central R. R., on Park Ave., New York city. In order to reach the new high-level drawbridge over the Harlem River, the grade will be changed, beginning at about 110th St., and the tracks will be on a steel viaduct instead of partly on a masonry viaduct and partly in a cut or depressed way along the middle of the street, as at present. This work was described and illustrated in our issue of May 25, 1893, and the progress of the work was noted in our issue of April 4, 1895. At the masonry viaduct two double-track timber trestles have been built, so that work on the removal of the old work can go on without interference with the traffic, which is extremely heavy. Where the line is in a cut the retaining walls were cut away at the locations for the columns and the brick piers for the column foundations were then erected, the surface of the foundation being level with the street surface. Some of the columns were then erected and the work of erecting the girders and floor was proceeded with. The space between the tracks being too limited to allow of the erection of the brick piers for the middle row of columns, heavy timber trusses spanning the cut will carry these girders until the structure is otherwise completed and traffic is transferred to it. As soon as this is done the piers will be built in the abandoned cut, the columns will be erected and fitted to the girders and the trusses removed. The cut will then be filled in to the street level.

The steel viaduct is being built by the New Jersey Steel & Iron Co., of Trenton, N. J., and the Elmira Bridge Co., of Elmira, N. Y., and the accompanying cut represents the traveler used by the former company. The cut shows the traveler at work at the site of the 125th St. station, at which place the viaduct is widened to cover nearly the full width of the avenue. The traveler has three triangular bents, each carrying a long trussed boom at the foot of the vertical mast.

EFFICIENCY OF EASTERN AND WESTERN COALS IN STEAM MAKING.

Mr. J. C. McMynn, M. E., of the testing bureau of R. W. Hunt & Co., contributes an article to "Electrical Engineering," giving results of tests of evaporation made on boilers using both Eastern and Western soft coals. The Eastern coals included Pocahontas, New River, Youghiogheny, Winifrede, Pittsburg and Hocking, and the Western coals were Illinois and Indiana lump, nut and screenings. From the figures given we have compiled the following tabular summary:

	Eastern coals.		Western coals.	
	Burned in plain furnaces, ave. of 11 tests.	Burned in pat. smokeless furnaces, ave. of 10 tests.	Burned in plain furnaces, ave. of 11 tests.	Burned in pat. smokeless furnaces, ave. of 15 tests.
Price per ton delivered	$2.94	$3.06	$1.60	$1.38
Water evaporated per lb. of coal, from and at 212°, lbs.	8.35	9.32	6.90	7.42
Equivalent in heat unit utilized per lb. of coal	8058.	8994.	6658.	7160.
Cost of evaporating 1,000 lbs. water from and at 212°, cts.	17.60	16.40	11.60	9.30

It should be said that the smokeless furnaces referred to are furnaces designed on correct principles, and do not include steam-jet devices. The greater saving which these smokeless furnaces make in burning Western coal is probably due to the large percentage of volatile matter contained in the Western coals, much of which is driven off unconsumed when the coal is burned in ordinary furnaces.

THE EFFECT OF FIRE ON STEEL BEAMS.

We illustrate herewith some steel beams from Simpson's building, at the corner of Queen and Yonge Sts., in Toronto, Ont., which was destroyed by fire on March 2, showing the effect of fire in warping and bending the beams. The building was a six-story and basement structure, about 118 × 157 ft., and was only recently completed.

The piers between the plate-glass windows on the ground floor of the new portion of the building were of stone. The main walls of the building above the first story were of pressed brick. The floors of the building were of wood, resting upon rolled I-beams, which were supported by vertical, built-up columns. The steel columns and beams were covered with Acme cement, metal lath being employed on the columns. It was not claimed that the building was fireproof; in fact, it is reported that an agent for terra-cotta fireproofing spent the greater part of a day endeavoring to induce the owner to use terra cotta in protecting the steelwork, but through motives of economy his offer was not accepted.

Of course, when the structure was exposed to fire, the heated metal soon buckled and caused the collapse of the structure.

We are indebted to Mr. Willis Chipman, M. Am. Soc. C. E., of Toronto, for the photograph from which our illustration is reproduced.

The course of litigation over air-brake patents appears to set continuously in favor of the Westinghouse company. The recent decision of Judge Morris, in the suit of the Westinghouse Co. against the Boyden Co., of Baltimore, published in our issue of March 28, has been issued by the Westinghouse company in pamphlet form. In a preface to the pamphlet the company points out its intention to put an end to infringements, now that the courts have passed upon its rights, in the following language:

"More than 400,000 freight cars are now equipped with the Westinghouse quick-action brake, and this type of brake has practically become the standard upon nearly all of the principal railways of this country. A few railway and private car companies have, however, been induced to purchase inferior and infringing brakes, regardless of the fact that the use of even a limited number of these devices seriously effects the efficiency of the standard apparatus, and also compels all those railway companies which recognize the importance of maintaining a standard brake to carry an increased stock of air-brake repair material for the purpose of maintaining these different kinds of brakes, forced upon them in interchange traffic, thereby introducing great confusion and increasing the cost of maintaining the brakes in working order. It is absolutely necessary, for the protection of the interest of those who are large owners and users of quick-action air-brakes, that this illegal interference with our rights and the accompanying depreciation of the value of the investment made by the railways in air-brakes shall be terminated as quickly as possible.

It has been the policy of this company to abstain from litigation with railway companies which have purchased infringing brake devices, until our claims were established by the courts through suits brought against the original manufacturers and vendors; but, in view of the character and extent of the rights which the courts have now established for us, we expect these rights to be promptly and fully recognized. We shall therefore be prepared to replace infringing devices with our standard apparatus upon terms which we feel quite sure will be recognized as extremely liberal. If within a reasonable time, however, this reminder fails to secure proper recognition on the part of the railways which have purchased infringing apparatus, we presume that no offence will be given if we resort to the usual legal remedies of an injunction and an account.

The government of Chile, on Feb. 9, passed a law guaranteeing 4½% on $6,500,000 of the securities of the Trans-Andine Railway, for twenty years. Work on the railway is being continued on the Argentine side, and it is now hoped that with this guarantee Messrs. Clark Bros., the holders of the Chilean concession can obtain the funds necessary to complete the roads. The unfinished part, however, includes the most difficult part of the work and almost continuous tunneling.

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PERSONALS.

Mr. J. L. Smith has been appointed Street Commissioner of Helena, Mont.

Mr. W. D. Kent has been appointed Commissioner of Public Works at Chicago, Ill.

Mr. Thomas M. Thompson has been appointed Director of Public Works at Philadelphia, Pa.

Mr. Geo. C. Wimberly has been appointed City Engineer of El Paso, Tex., vice Mr. J. L. Campbell.

Mr. M. T. Fitzpatrick has been appointed Roadmaster of the Kansas City, Fort Scott & Memphis R. R.

Mr. W. T. Williams, City Land Surveyor of New Bedford, Mass., has been appointed City Engineer of that place.

Capt. John G. Mann has been appointed General Manager of the Mobile & Ohio R. R., with offices at Mobile, Ala.

Mr. R. W. Patterson, Assistant Engineer on the Atchison, Topeka & Santa Fe R. R., died at Coraspolis, Pa., April 8.

Mr. C. S. Coddington, of Geneva, N. Y., has been appointed Superintendent of Repairs on the Cayuga & Seneca Canal.

Mr. George W. Tilson, formerly City Engineer of Omaha, Neb., has ben appointed Assistant Engineer in the Department of City Works at Brooklyn, N. Y.

Mr. James H. Windrim, formerly Director of Public Works of Philadelphia, Pa., has been elected President of the Contractors' Surety, Title & Trust Co., of that city.

Dr. Gideon E. Moore, of New York, Chief Chemist of the Passaic Zinc Co., and proprietor of laboratories for chemical and physical tests, died April 13, at the age of 53.

Mr. H. L. Abbott, C. E., until recently of Abbott Bros., civil and mechanical engineers, has been engaged by the Chicago Edison Co., and will have his headquarters in the Rookery Building, Chicago.

Mr. Leffert L. Buck, M. Am. Soc. C. E., of the class of 1868 of the Rensselaer Polytechnic Institute, delivered a lecture on "Suspension Bridges" before the students of that institution at Troy, N. Y., April 12.

Mr. William G. Warden, who died recently at Germantown, Pa., was one of the pioneers in establishing petroleum refining works in this city, and in the introduction of tank steamers for carrying oil in bulk.

Mr. John W. Burke, formerly with the engineering firm of Chappell & Burke, of Rutland, Vt., has opened an office at 45 Broadway, New York city, and will make a specialty of water-works, sewerage and municipal work.

Mr. W. A. Nettleton, Assistant Superintendent of Motive and Machinery of the Kansas City, Fort Scott & Memphis R. R., has been appointed Superintendent of Motive Power and Machinery, vice Mr. J. S. McCrum, resigned.

Mr. Henry Fitch, who died at Jersey City, N. J., April 15, at the age of 78, was one of the assistant engineers on the construction of the New York, Lake Erie & Western R. R., and later went into business as a bridge builder.

Mr. G. W. Vaughn, Vice-President, General Manager and Chief Engineer of the Santa Fe, Prescott & Phoenix Ry., is said to have resigned to accept a position in charge of the construction of the San Francisco & San Joaquin Valley R. R.

Mr. John Bisgood, Division Engineer of the Western Division of the Erie Canal, died at Rochester, N. Y., April 11, at the age of 72. He had held the position for about five years, having previously been assistant engineer and resident engineer on the canal.

The list of names of delegates to the International Railway Congress given in our issue of April 4 was incorrect, the list being that of the committee appointed by the American Railway Association to make arrangements for proper representation at the Congress. The only delegates thus far officially announced are Col. H. S. Haines and Mr. W. F. Allen, respectively President and Secretary of the Association.

R. Hinchliffe & Co. have opened an office at 100 Washington St., Chicago, to conduct a general practice as consulting civil and mechanical engineers and contractors, making a specialty of bridges and structural work. Mr. Hinchliffe was assistant engineer of construction of the Columbian Exposition. He had charge of the construction of the Mills Building, in San Francisco, Cal., and has had about 25 years' experience in general engineering.

Mr. W. H. Green has been appointed General Superintendent of the entire system of the Southern Ry. Co., with office at 1300 Pennsylvania Ave., Washington, D. C., reporting to the Third Vice-President. Mr. C. H. Hudson has been appointed Chief Engineer, vice Mr. C. M. Bolton, resigned, with office at 1300 Pennsylvania Ave., Washington, D. C., reporting to the Third Vice-President. The positions of General Manager of the Eastern and Western systems, respectively, have been abolished.

Prof. James Dwight Dana, Ph. D., LL. D., the famous mineralogist and author, died at New Haven, Conn., April 14, after a short illness. He was born in Utica, N. Y., Feb. 12, 1813, graduated at Yale College in 1833, and was appointed instructor in mathematics to midshipmen in the U. S. Navy. From 1836 to 1838 he was assistant to Prof. Benjamin Silliman, at Yale. From 1838 to 1842 he was mineralogist and geologist of the "Peacock" expedition to the Southern and Pacific oceans, sent out by the government under Capt. Wilkes, and he spent the next thirteen years in studying and preparing for publication the material he had collected. In 1844 he moved from Washington to New Haven, where he spent the rest of his life. He married the third daughter of Prof. Silliman. In 1850 he became associate editor of the "American Journal of Science and Arts," and became editor after Prof. Silliman's death. In 1855 he became Silliman professor of natural history and geology at Yale, and in 1864 the title of the professorship was changed to that of mineralogy and geology. In 1854 he was President of the American Society for the Advancement of Science. He received the Wollaston medal from the Geological Society of England in 1872. The University of Munich conferred upon him the degree of Ph. D. in 1872, and Harvard University conferred upon him the degree of LL. D. in 1886. In 1893 he retired from the active work of his professorship at Yale, but has since then been lecturing and working upon the subjects in which he was so much interested. Prof. Dana was a member of many scientific societies and the author of numerous works. His report on the government expedition of 1838 filled several volumes, and among his other published works were "A System of Mineralogy," 1837; "Manual of Mineralogy," 1848, which is familiar to almost every engineer; "Coral Reefs and Islands," 1853; "Manual of Geology," 1863; "Textbook of Geology," 1864; and "The Geological Story Briefly Told," 1875.

ENGINEERING SOCIETIES.

ENGINEERS' CLUB OF PHILADELPHIA.—At the meeting on April 6, Mr. E. H. Newell, Chief of the Hydrographic Division of the U. S. Geological Survey, read a paper upon "Methods and Results of Measurements of Stream Discharges, as made by the U. S. Geological Survey." L. F. Rondinella, Secy.

CIVIL ENGINEERS' CLUB OF CLEVELAND.—At the meeting on April 9, Prof. Chas. S. Howe presented a paper on "Solar Attachments to Transits," and gave also a description of Mr. John B. Davis' new solar instrument. F. A. Coburn, Secy.

WESTERN RAILWAY CLUB.—The regular monthly meeting of the club was held at the Auditorium Hotel, Chicago, April 16, and was devoted to a discussion of Mr. C. A. Goodnow's paper on the Train Staff System (Eng. News, April 11); a topical discussion on the Strength of Railway Car Axles, and the consideration of the M. C. B. Rules of Interchange. This last discussion was based upon the report of the club's committee upon the new rules of interchange (Eng. News, March 7) adopted by a number of Western railways, and will be given in some detail in a future issue.

WISCONSIN POLYTECHNIC SOCIETY.—At the regular meeting at Milwaukee, Wis., April 9, Mr. John Geist, of the Wisconsin Bridge & Iron Works, presented a paper describing various old types of lift bridges, and comparing late examples in Chicago with the Tower lift bridge at London and with the Holton St. and 16th St. bridges in Milwaukee.

W. K. Means, Secy.

COMING TECHNICAL MEETINGS.

ENGINEERS' CLUB OF PHILADELPHIA.
April 20. Secy., L. F. Rondinella, 1122 Girard St.
WISCONSIN POLYTECHNIC SOCIETY.
April 23. Secy., W. K. Means, Loan & Trust Building, Milwaukee.
DENVER SOCIETY OF CIVIL ENGINEERS.
April 23. Secy., H. Breen, 36 Jacobson Block.
CENTRAL RAILWAY CLUB.
April 24. Secy., H. D. Vought, Buffalo "Courier," Buffalo, N. Y.
CANADIAN SOCIETY OF CIVIL ENGINEERS.
April 25. Secy., C. H. McLeod, 12 Mansfield St., Montreal.
INDIANAPOLIS ENGINEERING CLUB.
April 27. Secy., C. C. Brown, City Engineer.
WESTERN SOCIETY OF ENGINEERS.
April 17. "Some Mississippi River Bridges," by Horace E. Horton. Secy., Chas. J. Roney, 1736 Monadnock Block, Chicago.
AMERICAN SOCIETY OF CIVIL ENGINEERS.
May 1. "Preservation of Iron Structures Exposed to the Weather," by E. Gerber. Secy., C. W. Hunt, 127 E. 23d St., N. Y. city.
ENGINEERS' CLUB OF ST. LOUIS.
May 1. "The Design of the Trainshed of the new Union Station at St. Louis," by George H. Pegram. Secy., W. H. Bryan, Turner Block.
TECHNICAL SOCIETY OF THE PACIFIC COAST.
May 3. Secy., O. H. Von Gelden, 819 Market St., San Francisco.
ENGINEERING CLUB OF COLUMBUS, O.
May 4. Secy., David Buell.
CIVIL ENGINEERS' SOCIETY OF ST. PAUL.
May 6. Secy., C. L. Aman, City Engineer's Office.
ENGINEERING SOCIETY OF WESTERN NEW YORK.
May 6. Secy., Geo. R. Sikes, 122 Pearl St., Buffalo, N. Y.
COLUMBIAN ENGINEERING SOCIETY.
May 7. Secy., W. F. Hart, University Building, 15th and H. Sts. N. W., Washington, D. C.
NEW ENGLAND RAILROAD CLUB.
May 8. Secy., F. M. Curtis, P. O. Box 1576, Boston, Mass.
AMERICAN SOCIETY OF MECHANICAL ENGINEERS.
May 8. "Compound Locomotives," by F. W. Dean. Secy., F. R. Hutton, 12 W. 31st St., N. Y. city.
ENGINEERS AND ARCHITECTS' CLUB OF LOUISVILLE.
May 9. Secy., James K. Zollinger, Norton Building.
ENGINEERING ASSOCIATION OF THE SOUTH.
May 9. Secy., H. D. Ruhm, Nashville, Tenn.
MONTANA SOCIETY OF CIVIL ENGINEERS.
May 11. Secy., Forrest J. Smith, Denver Block, Helena, Mont.
ENGINEERS' CLUB OF KANSAS CITY.
May 13. Secy., F. W. Tuttle, Baird Building.
NORTHWESTERN SOCIETY OF ENGINEERS.
May 14. Secy., D. W. McMorris, Burke Building, Seattle, Wash.
CIVIL ENGINEERS' CLUB OF CLEVELAND.
May 14. Secy., F. A. Coburn, Case Library Building.
NORTHWESTERN RAILWAY CLUB.
May 14. Secy., W. D. Crosman, Ryan Hotel, St. Paul.
ASSOCIATION OF ENGINEERS OF VIRGINIA.
May 15. Secy., J. H. Pilcher, Roanoke, Va.
ENGINEERS AND ARCHITECTS' ASSOCIATION OF SOUTHERN CALIFORNIA.
May 15. Secy., F. Van Vleck, Los Angeles, Cal.
BOSTON SOCIETY OF CIVIL ENGINEERS.
May 15. Secy. S. E. Tinkham, City Hall, Rooms 36 Bromfield St.
NEW YORK RAILROAD CLUB.
May 16. Secy., John A. Hill, 256 Broadway, N. Y. city.
ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.
May 16. Secy., D. Carhart, Carnegie Library Building, Allegheny.
ENGINEERS' CLUB OF CINCINNATI.
May 16. Secy., J. F. Wilson, Odd Fellows' Temple.
ENGINEERS' CLUB OF MINNEAPOLIS.
May 20. Secy., E. Nexson, Kasota Block.
WESTERN RAILWAY CLUB.
May 21. Secy., W. D. Crosman, Club Room 9, Grand Pacific Hotel, Chicago.
MASTER CAR BUILDERS' ASSOCIATION.
June 11. Annual Convention at Alexandria Bay, N. Y. Secy., J. W. Cloud, Rookery Building, Chicago, Ill.
ASSOCIATION OF RAILWAY TELEGRAPH SUPTS.
June 12. Montreal, Que. Secy., P. W. Drew, Wisconsin Central Ry., Milwaukee, Wis.
NORTHWESTERN TRACK AND BRIDGE ASSOCIATION.
June 14. Secy., D. W. Meeker, St. Paul, Minn.
AMERICAN RAILWAY MASTER MECHANICS' ASSOC'N.
June 17. Annual Convention at Alexandria Bay, N. Y. Secy., Angus Sinclair, 256 Broadway, New York city.

CONSTRUCTION NEWS.

CONDENSED LIST OF CONTRACTS PENDING WITH DATE OF OPENING BIDS.

Bids to be opened.	Work.	Place.	See Eng. News.
Apr. 19.	Water-works system	at Ft. Shaw, Mont.	Apr. 4
Apr. 19.	Pine lumber,	St. Louis, Mo.	Apr. 4
Apr. 19.	Sewer system,	Fort Shaw, Mont.	Apr. 4
Apr. 19.	Asphalt paving,	Washington, D. C.	Apr. 11
Apr. 19.	School house,	North Evans, N. Y.	Apr. 11
Apr. 20.	Bridge bonds ($39,000),	Glendive, Mont.	Apr. 4
Apr. 20.	Road,	Boston, Mass.	Apr. 11
Apr. 20.	Driven wells,	Norfolk, Va.	Apr. 11
	Advertised, Eng. News, Apr. 11.		
Apr. 20.	Brick paving,	Wheeling, W. Va.	Apr. 11
Apr. 20.	Bridge.	Rome, Ga.	Apr. 11
Apr. 20.	Brick paving,	Benwood, W. Va.	Apr. 11
Apr. 20.	Water meters,	Washington, D. C.	Apr. 11
	Advertised, Eng. News, Apr. 11.		
Apr. 20.	Sewer,	Brooklyn, N. Y.	Apr. 18
Apr. 22.	Elec. light bonds ($12,000),	Elberton, Ga.	Mar. 28
Apr. 22.	Pumping engine,	Homestead, Pa.	Apr. 4
	Advertised, Eng. News, Apr. 4 to 18.		
Apr. 22.	Water-works supplies,	Cincinnati, O.	Apr. 4
Apr. 22.	Bridge,	Kenton, O.	Apr. 4
Apr. 22.	Paving,	Medina, O.	Apr. 4
Apr. 22.	Iron bridge,	Binghamton, N. Y.	Apr. 11
	Advertised, Eng. News, April 11 and 18.		
Apr. 22.	Army buildings,	Davids Island, N. Y.	Apr. 11
Apr. 22.	Bank building,	Galveston, Tex.	Apr. 11
Apr. 22.	Street railway (3 miles),	McKeesport, Pa.	Apr. 11
Apr. 22.	Paving materials,	Baltimore, Md.	Apr. 11
Apr. 22.	Electric lighting,	Holyoke, Mass.	Apr. 11
Apr. 22.	Paving,	Brooklyn, N. Y.	Apr. 11
Apr. 22.	Belgian blocks (140,000),	Baltimore, Md.	Apr. 18
Apr. 22.	Macadamizing,	Laurel, Md.	Apr. 18
Apr. 22.	Printing house,	Toronto, Ont.	Apr. 18

Apr. 22. Water-works system, So. Whitley, Ind. Apr. 18
Apr. 22. Pumping engine, etc., Holland, Mich. Apr. 18
Apr. 22. Electric light plant, Holland, Mich. Apr. 18
Apr. 23. Hospital bldg. at Ship Island, Miss. Apr. 4
Apr. 23. Grading, Helena, Mont. Apr. 4
Apr. 23. Trenching, etc., Buffalo, N. Y. Apr. 11
Apr. 23. Bridge, Buffalo, N. Y. Apr. 11
Apr. 23. Earth excavation, etc., Boston, Mass. Apr. 11
Advertised, Eng. News, Apr. 18.
Apr. 23. Brick paving, Trenton, N. J. Apr. 18
Apr. 23. Water-works for parks, Chicago. Apr. 18
Apr. 23. Boulevard lamps (333), Chicago, Ill. Apr. 18
Apr. 23. Bridge, Trenton, N. J. Apr. 18
Apr. 23. Sewers, Trenton, N. J. Apr. 18
Apr. 23. Street supplies, etc., Wilmington, Del. Apr. 18
Apr. 24. Buildings, San Marcos, Tex. Mar. 28
Advertised, Eng. News, Mar. 28 to Apr. 11.
Apr. 24. Brick paving (30,000 sq. yds.) Dubuque Ia. Apr 18
Apr. 24. Water service pipes, Chicago, Ill. Apr. 18
Apr. 25. Water-works, West Troy, N. Y. Mar. 28
Apr. 25. Sewers (18 miles), Manchester, Va. Apr. 4
Advertised, Eng. News, Apr. 4 and 11.
Apr. 25. Sewer materials, Manchester, Va. Apr. 4
Advertised, Eng. News, Apr. 4 and 11.
Apr. 25. Stone road, Helena, Mont. Apr. 4
Apr. 25. 60-in. intake conduit, Erie, Pa. Apr. 4
Advertised, Eng. News, Apr. 4 and 11.
Apr. 25. Bridge, Gainesville, Ga. Apr. 4
Apr. 25. Lumber and hardware, Winnipeg, Man. Apr. 11
Apr. 25. Paving, Annapolis, Md. Apr. 18
Apr. 26. Sewers, Brooklyn, N. Y. Apr. 18
Advertised, Eng. News, Apr. 18.
Apr. 25. Sewers, Indianapolis, Ind. Apr. 18
Apr. 25. Electrical supplies, etc., Pittsburg, Pa. Apr. 18
Apr. 26. Electric lighting, Greensboro, N. C. Apr. 4
Apr. 26. Officers' quarters, Helena, Mont. Apr. 11
Apr. 26. Street improvements, St. Louis, Mo. Apr. 18
Apr. 26. Sewers, St. Louis, Mo. Apr. 18
Apr. 26. Exposition buildings, Atlanta, Ga. Apr. 18
Apr. 26. Repaving, etc., Philadelphia, Pa. Apr. 18
Apr. 27. School Bldg., Jefferson City, Mo. Apr. 18
Apr. 27. Buildings, Phoenix, N. Mex. Apr. 18
Apr. 29. Paving, Montgomery, Ala. Apr. 4
Apr. 29. Dredging, Wilmington, Del. Apr. 4
Apr. 29. Roads, Detroit, Mich. Apr. 11
Apr. 29. Bonds ($200,000), Minneapolis, Minn. Apr. 18
Apr. 29. Completing dry dock, B'klyn navy yd. Apr. 18
Apr. 29. Bridge, Louisville, Ky. Apr. 18
Apr. 29. Bonds ($100,000), Newport, R. I. Apr. 18
Apr. 30. Keeping Mobile River clear of timber. Apr. 4
Apr. 30. Cement, stone, etc., Mobile, Ala. Apr. 4
Advertised, Eng. News, Apr. 4 to 25.
Apr. 30. Street improv't bonds, Mt. Pleasant, O. Apr. 4
Apr. 30. Sea wall, Baltimore, Md. Apr. 11
Apr. 30. Post office building at Rimouski, Que. Apr. 11
Apr. 30. Cement (25,000 lbs.), Ottawa, Ont. Apr. 11
Apr. 30. Reservoir, Minneapolis, Minn. Apr. 18
Apr. 30. Pipe, valves, etc., Minneapolis, Minn. Apr. 18
Apr. 30. Brick paving (5 streets), Cincinnati, O. Apr. 18
Apr. 30. Steel plates, etc., Mare Island navy yd. Apr. 18
Apr. 30. Macadamizing (3¾ miles), Kansas City. Apr. 18
Apr. 30. Brick paving, Tipton, Ind. Apr. 18
Advertised, Eng. News, Apr. 18 and 25.
Apr. 30. Bridge, Kansas City, Mo. Apr. 18
Apr. 30. Jail, Dawson, Ga. Mar. 28
May 1. Sewer system, Sudbury, Ont. Mar. 28
May 1. Water-works system, Sudbury, Ont. Mar. 28
May 1. Buildings, New Orleans, La. Mar. 28
Advertised, Eng. News, Mar. 28 to Apr. 18.
May 1. Metalwork, New Orleans, La. Mar. 28
Advertised, Eng. News, Mar. 28 to Apr. 18.
May 1. Water bonds ($10,000), Cascade, Ia. Apr. 4
May 1. Stone and asphalt paving, Cleveland. Apr. 4
May 1. Dredging, Oswego, N. Y. Apr. 11
May 1. Post office building, Bloomington, Ill. Apr. 11
May 1. Brick paving, Peoria, Ill. Apr. 11
Advertised, Eng. News, Apr. 11 to 25.
May 1. Sewers (20 miles), Williamsbridge, N. Y. Apr. 11
Advertised, Eng. News, Apr. 11 to 25.
May 1. Drill hall, Plattsburg, N. Y. Apr. 11
May 1. Road, etc., New York, N. Y. Apr. 18
May 1. Pumping station, Russell, Kan. Apr. 18
May 1. Pumping station, Ulysses, Kan. Apr. 18
May 1. Floodwater channel, Altoona, Pa. Apr. 18
Advertised, Eng. News, Apr. 18.
May 1. Water-works system, Grantsburg, Wis. Apr. 18
May 1. Bridge, Chestertown, Md. Apr. 18
May 1. Bridge, Kieler, Wis. Apr. 18
May 2. Pipe sewers, Barrie, Ont. Apr. 18
May 2. Macadamizing (3 miles), Kansas City, Mo. Apr. 18
May 2. Macadamizing, etc., Barrie, Ont. Apr. 18
May 2. Dredging, Detroit, Mich. Apr. 18
Advertised, Eng. News, Apr. 18 and 25.
May 2. Jail, Grand Rapids, Mich. Apr. 18
May 3. Brick sewers, Richmond, Ind. Apr. 11
May 3. Pipe sewers, Richmond, Ind. Apr. 11
May 3 Life saving station at Gay Head, Mass. Apr. 18
Advertised, Eng. News, Apr. 18 and 25.
May 4. Roads (7½ miles), Vevay, Ind. Apr. 4
May 6. Bridges, Los Angeles, Cal. Apr. 11
May 6. Sewers, Cincinnati, O. Apr. 11
May 6. Paving, Cincinnati, O. Apr. 11
May 6. Bridge, Meridian, Miss. Apr. 18
May 7. Paving, Terre Haute, Ind. Apr. 11
May 7. Bridge, Houghton, Mich. Apr. 18
May 9. Pumping engines, Brooklyn, N. Y. Apr. 11
Advertised, Eng. News, Apr. 11.
May 9. Courthouse, Decatur, Tex. Apr. 18
May 10. Bridge, Plymouth, Ind. Apr. 11
May 11. Stone, Pittsburg, Pa. Apr. 18
Advertised, Eng. News, Apr. 18 to May 2.
May 11. Schoolhouse, Cleveland, O. Apr. 18
May 13. Plans for court house, Liberty, Tex. Apr. 11
May 13. Sewers, Yonkers, N. Y. Apr. 18
May 14. Levee (600,000 cu. yds.), Rock Isind, Ill. Apr. 18
Advertised, Eng. News, Apr. 18 to May 9.
May 14. Coal, Wilmington, N. C. Apr. 18
Advertised, Eng. News, Apr. 18 to May 9.
May 15. Smokeless powder, Washington, D. C. Apr. 4
May 15. Bridge, Glendive, Mont. Apr. 4
May 15. Memorial hall, West Point, N. Y. Apr. 11
Advertised, Eng. News, Apr. 11 to May 2.
May 15. Plans, etc., for bridge, Montreal Jan. 24
Advertised, Eng. News, Jan. 24 and 31.
May 15. Barracks, etc., at Fort Myer, Va. Apr. 18
May 15. Bonds ($215,000), Schenectady, N. Y. Apr. 18
May 20. Water bonds, Santa Clara, Cal. Mar. 7
Advertised, Eng. News, Mar. 7 to 28.
May 20. Court-house, Wrightsville, Ga. Apr. 4
May 21. Dredging, Montgomery, Ala. Apr. 18
Advertised, Eng. News, Apr. 18 to May 9.
May 23. Water-wks. system, Santa Clara, Cal. Mar. 7
Advertised, Eng. News, Mar. 7 to 28.
May 23. Bridge, Winnipeg, Man. Apr. 18

Jun. 3. Courthouse plans, Winfield, W. Va. Apr. 18
Jun. 7. Bridge, Versailles, Ind. Apr. 18
Jun. 15. Irrigation canal, Portland, Ore. Apr. 18
July 3. Bridges, Ukiah, Cal. Apr. 18
Oct. 1. Plans for art building, Philadelphia, Pa. Apr. 11

RAILWAYS.

East of Chicago.

BANGOR & AROOSTOOK.—A branch from Caribou, Me., to Limestone will probably be built at an early date. Ch. Engr., Moses A. Burpee, Bangor, Me.

CHICAGO, INDIANA & EASTERN.—The construction of this railway was noted last week. The company has been recently reorganized by H. M. Alberger, of Chicago, who is now president and general manager. H. E. Drew, of Indianapolis, is the contractor, and Fremont Wilson, of Fairmount, the chief engineer.

CHICAGO, LAKE SHORE & EASTERN.—Incorporated in Indiana April 10 to build a railway from the west line of Hobart township, Lake county, west and northwest to a point on the Illinois state line, a distance of about 20 miles; capital stock, $500,000; directors, W. G. Brinson, E. C. Crane, Frank L. Wear, J. S. Keefe, and E. P. Prentice.

HUDSON RIVER & CORNELL.—Incorporated in New York to build a railway ten miles long, from Croton-on-Hudson to Cornell; capital stock, $100,000; directors, J. S. Coleman, C. J. Ryan, H. H. Brown, B. F. Coleman, C. J. Ryan, Jr., W. Kennelly and J. B. Greene, of New York, and Charles Dayton, of Brooklyn.

ILLINOIS, INDIANA & MICHIGAN.—A press report from Michigan City, Ind., states that the annual meeting of this company was held in that city April 11, and the following directors elected: Congressman William A. Smith, Thomas Hefferan, and F. H. Jewell, of Grand Rapids; J. E. Wyman, of New York, and H. D. Tuttle, of Boston. The road is to extend from the Indiana state line to Chicago, and it is stated that the right of way has been secured and 12 miles of track laid.

IRON RANGE & HURON BAY.—It is stated that the work which was suspended three years ago will soon be resumed upon this road, and the line built to Champion, Mich., at once, and to Ontonagon this summer. The road was built from Huron Bay to within a mile or two of Champion in 1892. Gen. Supt., S. Keeler, Arvon, Mich.

PATTEN & SHERMAN.—A. A. Burleigh, Pres., Houlton, Me., writes us that this railway will be 8¾ miles in length, extending from Patten to Crystal, Sherman and Sherman Mills, Me. The surveys have been completed, capital stock taken and part of the right of way obtained. The construction will be commenced the last of this month. The work will be done by the company and not by contract. Ch. Engr., W. Z. Earl, Houlton, Me.

PORT JERVIS, MONTICELLO & NEW YORK.—Press reports state that Haines Bros. of Kinderhook, N. Y., have recently purchased this short road, and will extend it down the Rondout Valley to Kingston, N. Y. Receiver, Benj. Ryall, Port Jervis, N. Y.

TERRE HAUTE, OLNEY & CHESTER.—A meeting was held at Terre Haute, Ind., last week, and steps taken to secure surveys for this road, which it is hoped to build at an early date. Pres., J. W. Horner, Olney, Ill.; Vice-Pres., Russell B. Harrison, Terre Haute, Ind.; Secy. and Gen. Man., F. N. Boyer, Olney, Ill. The project was noted in our issue of March 28.

WATERVILLE & WISCASSET.—The incorporators of this company met at Waterville, Me., last week, and elected the following officers: Pres., I. C. Libey; Clk., W. T. Haines; Treas., Frank Reddington, of Waterville.

Southern.

CHESAPEAKE & OHIO.—This company has completed the work of double-tracking its line from Kenova, W. Va., to Ashland, Ky. The entire line from Cincinnati to Washington is to be double-tracked.

CHESAPEAKE & WESTERN.—P. S. Thomas, of Harrisonburg, Va., writes us that this road is projected from tidewater west to Charleston, W. Va. The $150,000 necessary to secure the route through Rockingham county, 40 miles, has been awarded to E. Purcell, Jr., of Harrisonburg, Va. The work of construction is under the supervision of the Old Dominion Construction Co., 1 Broadway, New York. Walker Bros., of Harrisonburg, are the engineers.

CHICAGO, FLORENCE & GULF.—This company recently secured a charter from the Alabama legislature for a road from Fort Malden on the gulf to the Tennessee state line. The incorporators are Hall Hodges, R. A. Mitchell, W. C. Jenson, and others.

CRAWFORD COAL CO.—This company, of Terre Haute, Ind., is surveying for a railway about 60 miles long through Fentress county, Tenn. The construction will probably begin in July.

MANCHESTER & AUGUSTA.—There is talk of building a branch of this road from a point on the line between Rimini and Denmark, S. C., south, to Harland City, 6 miles, to connect with the Charleston, Sumter & Northern. Gen. Supt., J. F. Devine, Wilmington, N. C.

Northwest.

CHICAGO, IOWA & MINNESOTA.—Press reports form Alden, Ia. state that Judd Bradley, of Webster City, has commenced the survey of this road from that city to Oakland Valley, Wall Lake, Clarion and Britt, and thence to the state line.

CHICAGO & LAKE SUPERIOR.—Incorporated in Wisconsin as a reorganization of the old Koshkong Valley R. R. Co.; capital stock, $500,000. This is said to be a scheme to give the Illinois Central a line to Duluth. Only a short piece of track will be built connecting the towns of Portage and Madison. North of Portage the Illinois Central will have a traffic arrangement with the Wisconsin Central. The road is to be built by the Western Construction Co., which was incorporated April 3 to build a railway from Cambridge, Wis., south to the state line, and north to Superior, 320 miles; incorporators, C. G. Norton, of Oconomowoc, and E. J. Foster, F. B. Hanchet and F. W. Hall, of Madison, Wis.

DAVENPORT, CLINTON & EASTON.—Incorporated in Iowa to build a railway from Davenport through Princeton and Le Clare to Clinton, where a connection will be made with the Chicago & Northwestern. It is stated that a considerable portion of the right of way has already been secured and that it is expected the construction will be commenced at an early date; capital stock, $500,000; incorporators, Loren N. Downs, of New York; D. A. McGugin and Henry Schnitger, of Davenport, Ia.

FORT DODGE & POCAHONTAS.—This company has been organized to build a railway between Fort Dodge and Pocahontas Center, Ia. M. D. O'Connell, George R. Pearsons, C. L. Granger, A. R. Loomis and J. B. Butler of Fort Dodge, Ia., are interested.

LOGGING ROAD.—A press report from Marinette, Wis., states that Holmes & Son, intend to extend their logging railway about six miles this year. The road is standard gage.

LONDON & CAMBRIDGE.—Press reports state that a contract has been awarded for constructing a railway from London, Wis., on the Chicago & Northwestern, to Cambridge, three miles, to be completed by July 1, and that a further extension is contemplated.

LANGENBURG & SOUTHERN.—Notice is given that application will be made at the next session of the Canadian Parliament for a charter for this company with power to build a railway from Langenburg, in Assiniboia, to some point on the Canadian Pacific, between Red Jacket and Elkhorn, Man., with a branch to Binscarth, Man. Kingsmill, Saunders & Torrance, solicitors.

MERRILL, ANTIGO & WESTERN.—The Badger Construction Co. has been organized at La Crosse, Wis., with a capital stock of $250,000, to build this railway, noted in our issue of last week. F. P. Hickson, J. M. Hickson and Geo. H. Gordan are incorporators of the construction company.

Southwest.

CENTRAL LOUISIANA.—Hampden Story, Pres., Rayne, La., writes us that surveys will be commenced about the middle of this month for this railway. The line will extend through Abbeville, Rayne, Church Point, Opelousas and Washington to a connection with the Texas & Pacific, a distance of 60 miles. Ch. Engr., Welman Bradford, Rayne, La.

KANSAS CITY & NORTHERN BELT.—Incorporated in Kansas, April 8, to build a standard gage railway to improve the north bottoms of Kansas City, where there are over 200 acres of land said to be practically useless. The road will extend from the state line along the Missouri River to Quindaro, with branches to Argentine, Kansas City and Leavenworth, and the construction will be commenced at once. Capital stock, $500,000; directors, W. L. Parkinson, of Ottawa, Kan., one of the owners of the sugar works at Fort Scott; J. S. Stockton, S. S. Matthews, N. McAlpin, J. W. Jenkins and Thos. J. Barber, of Kansas City, Kan.; S. A. Matthews, of Kansas City, Mo.; J. W. Taylor, of Leavenworth, and others.

MISSOURI, KANSAS & TEXAS.—Press reports state that construction will be begun soon on the extension from Sedalia, Mo., to Kansas City and that the Southwest Construction Co. has the contract for building the line.

SOUTHERN PACIFIC.—E. P. Cushing, Resident Engr., Houston, Tex., writes us that the contract for 25 miles of double track on the M. L. & T., noted in our issue of March 28, was awarded on April 6 to Downey Bros., of Houston, Tex. This contract embraces the grading, but will probably include the tracklaying also.

WATKINS.—The Watkins R. R. Co. has been organized at New Orleans, La., by R. T. McDonald, M. J. Hart, T. A. Clayton and others, to acquire the franchise held by W. H. Watkins for a belt line in Orleans, St. Bernard and Jefferson parishes.

Rocky Mt. and Pacific.

ASTORIA & COLUMBIA RIVER.—A. B. Hammond, Edwin Stone and C. W. Fulton have filed articles of incorporation for this company, noted last week. The citizens of Astoria, Ore., are reported to have signed a new contract for the construction of the proposed road from that city to Goble. It is stated that engineers are now going over the line preparatory to the awarding of contracts.

CRIPPLE CREEK BELT.—Incorporated in Colorado to build a railway from Cripple Creek to Altman and mines in the Cripple Creek mining district; capital stock, $300,000; incorporators, Spencer Penrose, R. N. Mayfield, E. B. Maghee, A. E. Mayfield and J. H. Freeman, Jr.

COLUMBIA & RED MOUNTAIN.—D. C. Corbin, Pres., Spokane, Wash., writes us that this railway is projected from Northport, Wash., on the Spokane Falls & Northern (of which Mr. Corbin is also president), north to Red Mountain and Trail Creek, B. C., a distance of 15 miles. Information in regard to the construction cannot be given for about 60 days. Ch. Engr., E. J. Roberts, Spokane, Wash.

INTER-MOUNTAIN.—Incorporated in Colorado to build a railway from Denver to Ward by way of Boulder; capital stock, $300,000; incorporators, S. C. Brown, J. S. Switzer, James Cowie, E. A. Austin, and Geo. F. Foude, all of Boulder, Colo.

ROGUE RIVER VALLEY.—This company is reported to have filed supplementary articles of incorporation, providing for an extension from Medford, Ore., northeasterly through Jackson and Klamath counties to a point on Upper Klamath Lake, about 50 miles. The road is now in operation from Jacksonville to Medford, 6 miles. Pres., William Honeyman; Secy., W. A. Buchanan; Treas. and Man., E. J. De Hart, Portland, Ore.

SAN DIEGO & SALT LAKE CITY.—Thomas Taylor, of Utah, has been in San Diego, Cal., in the interest of a railway projected between Salt Lake City and San Diego. Mr. Taylor is said to be a wealthy capitalist and a prominent member of the Mormon church.

Foreign.

TAMPICO & RIO GRANDE.—Another report from the city of Mexico states that the government has granted a valuable concession, with subsidy, to the

Tampico and Rio Grande R. R., to be built by Chicago and Boston capitalists. The road will run from Barroteran, Coahuila, to Nuevo Laredo, thence down the Rio Grande, thence to Tampico, forming a part of the Pan-American system along the coast to Tampico, and ultimately to this city, traversing rich agricultural and mining regions. The company owns rich coal mines at Barroteran. Surveys will commence immediately. Concessionaire McCracken and Attorney Figueros left April 4 for Chicago.

STREET AND ELECTRIC RAILWAYS.

BALDWIN, ME.—The Ossipee Valley Electric Ry. Co. has been organized to build a road throuh this place, Cornish, Parsonsfield, Hiram and Porter. Clark E. Varney, of Somerville, Mass., and Edward H. Burt, of Boston, are interested.

BEVERLY, MASS.—The Boston, Lynn & Beverly St. Ry. Co. has been organized to build an electric elevated or surface railway under the Boynton bicycle railway patent, the roads to be elevated within city limits; estimated cost, $100,000 a mile in the cities, and $10,000 a mile outside.

ALBANY, N. Y.—Frederick R. Barnes has petitioned for a franchise for an electric railway.

BROOKLYN, N. Y.—It is reported that work will soon commence on the proposed Long Island Electric Ry., the route of which is reported as follows: The main line of the road is to run parallel with the tracks of the Long Island R. R., through the south side of Long Island, and taking in on its route, Springfield, Valley Stream, Rockville Center, Oceanville, Baldwins, Millburn, Freeport, Merrick, New Bridge, Seaford, and then on to Babylon, and through to the Islips. A spur of the road, commencing at Jamaica, will tap the country contiguous to Far Rockaway, and then run along the shore to Rockaway. Another branch will run north and south from the main line at Rockville Center, tapping Hempstead Village, Garden City and Mineola on the north, and East Rockaway, Barnum Post Office, and on to Long Beach. This is the projected route at present, but ultimately the company hope to pass into Suffolk county and make a central point at Patchogue. The company begins with a capital stock of about $600,000, but it is understood to have a backing sufficient to make any reasonable projection of its route feasible. Concessions have been granted for the road from Far Rockaway and Jamaica to East Rockaway, Rockville Center and Hempstead. A. R. Hart, of New York; Clarence Wolf, of Philadelphia; C. H. Mullin, of Mount Holly Springs, Pa., and J. C. Van Arx, Charles M. Cooper, and Wm. H. English, are interested.

GREENWOOD LAKE, N. Y.—It is reported that Abram S. Hewitt, of New York, is considering the question of equipping the New York & Greenwood Lake Ry., 48 miles in length, with electricity, power to be supplied from Greenwood Lake.

MIDDLETOWN, N. Y.—The Middletown & Bloomsburg Electric Ry. Co. has been incorporated to build a railway 10 miles in length; capital stock, $200,000; directors, J. C. Hinchcliffe, of Paterson, N. J.; W. B. Rockwell, of Scranton, Pa., and E. G. Wightman and W. H. Wiggins, of Middletown.

NEW YORK, N. Y.—The People's Traction Co. and the New York, Westchester & Connecticut R. R. Co. have petitioned for franchises on 21 miles of streets in the northern part of the city and 36 miles in Westchester county. Franklin Bartlett and John De Hart are interested.

NIAGARA FALLS, N. Y.—The Niagara Falls & Lewiston Electric Ry. Co. has awarded the contract for grading and constructing its road from Niagara Falls to Lewiston, a distance of seven miles, to Crage & Tench, of Buffalo. The road is to be in operation by July. The contract for cars 34 ft. in length will probably soon be awarded.

OGDENSBURG, N. Y.—The Ogdensburg St. Ry. Co. has engaged Wm. J. Akin to prepare plans for a new power house, water power to be used to generate the electricity. Gen. Man., H. B. Howard.

PORT WASHINGTON, N. Y.—It is reported that a syndicate will petition for a franchise for an electric railway to connect Roslyn, Port Washington and Great Neck, a distance of 15 miles, on Long Island. J. H. Bunnell, of J. H. Bunnell & Co., New York; Thomas Fay, of the Standard Oil Co., and J. H. King, of the Union Motor Works at Sands Point, are interested.

ASBURY PARK, N. J.—The Atlantic Coast Electric R. R. Co. has been incorporated, with a capital stock of $1,000,000, with $25,000 paid in; incorporators, Wm. H. Hurst, 238 Central Park West, New York; John J. Welsh, 6 East 93d St., New York, and Lawrence T. Fell, Orange, N. J.

COLUMBIA, PA.—It is reported that final arrangements are being made for the construction of the Columbia, Mount Joy & Ironville Electric Ry. Pres., James L. Hetherington; Treas., Walter N. Boyer; Constr. Engr., E. N. Smith.

PITTSBURG, PA.—The Citizens' Traction Co. has petitioned for permission to extend its electric road to Brilliant Station. Gen. Man., J. E. Rugg.

TOWANDA, PA.—It is reported that preparations are being made by the Towanda Traction Co. to construct an electric road from Greenwood to North Towanda. The construction of the road to Canton, Troy, Ulster, and Athens is also being considered. Pres., W. A. Heller, of Allentown.

BALTIMORE, MD.—A. S. Watkins, Secy., 503 Fidelity Bldg., writes us that the Baltimore, Bay Ridge & Ocean City Electric R. R. Co. will start a final survey in a few days for its road from this city to Westport, Glenburnie, Annapolis, Bay Ridge and Ocean City, a distance of 29 miles. Right of way has been obtained and capital partly secured. Ch. Engr., Henry Yewell Bready, who will build the power house and do all necessary construction. Pres., O. P. Baker, 110 St. Paul St.

BALTIMORE, MD.—The Baltimore Traction Co., the Edmondson Ave., Catonsville & Ellicott Cy. Electric Ry. Co., and the Central Ry. Co. have applied for permission to extend their electric roads.

RICHMOND, VA.—Andrew Pizzini, of Richmond; E. A. Catlin, of New York, and Martin & Pendleton, of Richmond and Washington, have applied for franchises for an electric railway on Broad St., estimated to cost $400,000.

SANFORD, FLA.—J. M. Saunders has been granted a franchise for an electric railway.

BELLEVILLE, MICH.—The town board has granted an electric railway franchise through Van Buren township. It is proposed to build this railway from Ann Arbor to Detroit, by way of Ypsilanti, Wayne and Dearborn.

PONTIAC, MICH.—It is reported that surveys are being made for an electric railway between this place and Sylvan Lake, and that Geo. H. Barbour and M. B. Mills are interested.

CHICAGO, ILL.—Press reports state that the Chicago & Worth Electric St. Ry. Co., with a capital stock of $2,000,000, will soon ask for a franchise covering 28 miles of streets on the west side of this city. Mrs. Hetty Green is said to be the financial backer of the company.——It is reported that bids will soon be received for constructing the western extension of the Lake St. Elevated Ry. to Austin.——The Northwestern Elevated Ry. Co. has awarded the contract for the foundations of the superstructure from Wilson and Evanston Aves. to Lake St. to Angus & Gindale, of Chicago, the work to be completed within one year.——The Metropolitan Electric St. Ry. Co. has been incorporated; capital stock, $5,000,000; incorporators, Robt. P. Parker, Richard E. Breed and James F. Dagley.

ELGIN, ILL.—The Carpentersville, Elgin & Aurora Ry. Co. has been organized to consolidate the electric railways of Elgin and Aurora, and to build a road from Aurora to Carpentersville, by way of Dundee, Elgin, St. Charles, Geneva and Batavia; capital stock, $1,200,000; J. B. Lane and A. B. Church are interested.

MILWAUKEE, WIS.—The railroad committee has recommended that the Milwaukee & Wauwatosa Motor Ry. Co. be granted right of way for its electric road from this city to Waukesha, a distance of 15 miles. The capital stock will be increased $150,000, and it is estimated that the road, with equipment, will cost about that amount. Pres., James Petley; Secy., A. B. Meyers.

ST. LOUIS, MO.—The King's Highway R. R. Co. has been granted a franchise for an electric railway to connect downtown roads.

DALLAS, TEX.—It is reported that the Dallas & Oak Cliff Electric Ry. Co. proposes to extend its road to Fort Worth. Pres., H. C. Scott, of St. Louis, Mo.; Supt., B. F. Sibert.

DENVER, COLO.—The residents of Jefferson Ave. have petitioned the Berkeley Electric Ry. Co. to extend its road to Mount Olivet cemetery, according to reports.

LOS ANGELES, CAL.—The Los Angeles & Santa Monica Electric R. R. Co. has been incorporated to build a railway between this place and Santa Monica, with a branch to Pasadena, a distance of 15 miles, and another branch five miles long to Cold Water Canyon; capital stock, $500,000, with $50,000 paid in. Treas., A. W. Eames; directors, C. B. Van Avery, V. H. Raleigh and J. J. O'Brien.

ST. JOHN, N. B.—It is reported that the street railway will be extended to Fairville and to Lily Lake. H. H. McLean and William Van Horne are interested.

ELECTRIC LIGHT AND POWER.

BUFFALO, N. Y.—Press reports state that a subcommittee of the council has prepared a report upon the franchise asked by the Niagara Falls Power Co. The company sought a franchise for 25 years, but the committee has compromised on 15 years. The committee will also recommend that the council demand a fixed rate of charges for the city by which power will not exceed $20 per HP. per year, and arc lights for street lighting shall cost no more than $50 a year. The city now pays the General Electric Co. $125 for each arc light. The report will further stipulate that 10,000 HP. shall be ready for distribution in Buffalo by September. This question was discussed editorially in our issue of March 28.

CHARLOTTE, N. Y.—The Rochester, Charlotte & Manitou R. R. Co. has petitioned the legislature for permission to transmit power to this place and other villages in Monroe county for lighting and other purposes.

PITTSBURG, PA.—Bids are asked until April 25 for furnishing electrical and other supplies for one year. George Booth, Dir. Dept. Charities.

FAYETTEVILLE, N. C.—It is reported that an election will be held May 6 to vote on a proposition to issue $10,000 in bonds for an electric light plant.

ATHENS, GA.—It is stated that work will be commenced on an electric plant at Mitchell's Bridge, on the Oconee River, where it is thought that 800 HP. can be developed and transmitted to Athens. W. S. Holman, J. Y. Carithers, A. P. Dearing and J. A. Hunnicutt, of the Athens St. Ry. Co., are interested.

LONGWOOD, FLA.—It is proposed to construct two power plants of 100 HP. each, and one plant of 300 HP., for a projected railway. The entire system is estimated to cost $400,000. Engr., E. W. Hencke.

BIRMINGHAM, ALA.—Thomas Parvis has been awarded the contract for constructing the new 2-story power house (150 × 146 ft.) for the Consolidated Electric Light Co. It is reported that the plant will have five engines of 2,500 HP. each, estimated to cost $200,000.

PASS CHRISTIAN, MISS.—Maurice Kaufmann has been granted a 50-year franchise for an electric light plant.

COLUMBUS, O.—It is reported that the state board of agriculture has decided to put in an electric light plant at the fair grounds, estimated to cost $20,000.

GRAND RAPIDS, MICH.—Fred A. Twamley, Secy. Bd. Pub. Wks., writes us that nothing has been done in regard to municipal electric lighting, except last year the people voted authorizing the council to issue bonds to build a plant, but the council has not yet made the loan.

CONNERSVILLE, IND.—Press reports state that the council has decided to put in a municipal electric light plant, estimated to cost $12,000 to $20,000.

BELLEVILLE, MICH.—It is reported that a company will soon be incorporated to build a dam at French Landing, six miles from this place, 312 ft. in length, where it is proposed to develop about 7,000 E. HP., which will be transmitted to towns within a radius of 15 miles. It is estimated that the plant will cost $250,000. Capt. Anthony and A. E. Coy are interested. This project was noted April 4.

HOLLAND, MICH.—Bids are asked until April 22 for an engine, condenser, etc. for an electric light plant. Geo. H. Sipp, Clk. Bd. Pub. Wks.

COOKSVILLE, ILL.—J. A. Crawford and R. E. Meharry have been granted a twenty-year franchise for an electric light plant.

APPLETON, WIS.—Press reports state as follows: Plans are being prepared for extensive alterations and improvements to be made this season to the lower water power at the third dam in this city by the Green Bay & Mississippi Canal Co., the Northwestern Ry. Co., and the Mfg. Investment Co. On the west side of the river below the dam, where the flow of water from the tail races is impeded by the Northwestern Ry. trestle, the track will be moved 100 ft. out into the river and the trestle replaced by an embankment of masonry and gravel about 600 ft. long, thus giving free flow to the waste water. On the west side the guard lock will be removed from the head of the Telulah water power canal to a point where the main roadway bridge crosses and the present wooden bridge replaced by an iron one. The head of the canal will be dredged out, allowing for a greater flow of water and more power. The manufacturing company, which at present takes its power from the government canal, will cut a canal to the power house from the Telulah canal, thus receiving water from either or both canals. This cut will necessitate several bridges for the crossing of the railway tracks and roadway. These improvements will increase the amount of power from the lower dam. The work will begin soon.

PRINCETON, MINN.—The citizens have voted to issue bonds for electric lights and water-works.

NEWCASTLE, WYO.—It is reported that plans are about completed for an electric light plant, work on which will soon begin.

KLAMATH FALLS, ORE.—The trustees have passed a resolution to issue $10,000 in bonds for electric lights and water-works.

ALHAMBRA, CAL.—It is reported that the construction of an electric light plant at this place is being considered.

LOS ANGELES, CAL.—A. P. Maginnis has been granted a franchise for an electric light plant.

NEW COMPANIES.—Iowa Falls Electric Light & Power Co., Iowa Falls, Ia.; $15,000; L. B. Bradley, H. C. Miller. Chemical Power Co., Rockford, Ill.; $10,000; to manufacture engines and motors; James Kennedy, Patrick W. Nelch, John H. Conlon.

Belle Vernon Electric Light & Power Co., Belle Vernon, Pa.; $1,000, with $200 paid in; Treas., Adolph G. Hamm.

Standard Telephone & Electric Co., Minneapolis, Minn.; $50,000; S. S. Kilvington, E. W. Batchelder, H. C. Dodge.

Murphysboro Water-Works & Electric & Gas Light Co., Murphysboro, Ill.; capital stock increased from $60,000 to $80,000.

Hartford Light & Power Co., Hartford, Ind.; $30,000; W. N. Forbis, Monticello; M. H. Forbis, Cincinnati; Albert Reynolds, Hartford.

New York Electric Motor & Ventilator Co., New York, N. Y.; $30,000; Sidney Green, New York; C. A. Sherman, Lincoln, Brooklyn.

Glasgow Water & Light Co., Glasgow, Mont.; $25,000; Pres., Chas. E. Hall; Vice-Pres., E. D. Coleman; Secy., A. W. Mahon; Treas., J. L. Truscott.

Globe Electric Construction Co., New York, N. Y.; $20,000; J. J. Clark, F. F. Coen, New York; H. C. Mackenzie, Roseville, N. J.; P. M. Mowrey, Upper Montclair, N. J.

Denver Electric Track Co., Denver, Colo.; $25,000; to have racing by electric light; C. J. Roentgen, St. Louis, Mo.; Edward D. Kirk, Kansas City; Geo. M. Sanders, Denver.

Dover Electric Light & Power Co., Dover Plains, N. Y.; $10,000; to furnish light to Dover, Annessia, Washington and Pawling; Adolph Reimer, Dover Plains; Julius C. Minck, Brooklyn.

Inter-State Power Co., Niles, Mich.; to build a dam across St. Joseph's River at South Bend, Ind., for generating electric power; Pres., Fred Elee, Dowagiac; Vice-Pres., Roscoe D. Dix, Berrien Springs; Secy., J. O. Beecraft, Dowagiac.

Empire State Electric Forging Co., Syracuse, N. Y.; to manufacture electric welding, forging and smelting apparatus; $300,000; L. H. Goolsbeck, O. M. Warner, Syracuse; J. O. Adsit, Hornellsville; D. E. Mosely, Rochester; E. D. Woodruff, Auburn.

Adams & Bagnall Electric Co., Cleveland, O.; $150,000; to manufacture electric lamps, motors and electrical machinery; Thos. E. Adams, of the Brush Electric Co.; E. J. Bagnall, St. Louis, Mo.; Chas. G. Hickox, H. W. Corning, C. W. Phillips.

BRIDGES.

LANCASTER, N. H.—The recent high water is reported to have carried away a $10,000 iron bridge in this town.

CHICOPEE, MASS.—The R. F. Hawkins Iron Works has been awarded the contract for a new bridge at the Falls, at $26,745.

NEW HAVEN, CONN.—The secretary of war has informed the city officials that a drawbridge is necessary in place of the present structure on Grand Ave. The bridge must be completed before Jan. 1, 1897.

ALBANY, N. Y.—The superintendent of public works has awarded the following contracts: For an iron canal bridge at High St., Cohoes, to the Groton Bridge & Mfg. Co., Groton, $3,722; canal bridge at Mann Ave., Cohoes, Hilton Bridge Co., Albany, $2,833; bridge over Glens Falls feeder of Champlain Canal at Basin St., Sandy Hill, to Rilley, Reardon & Dempsey, Sandy Hill, $2,498.

NEW YORK, N. Y.—There seems to be no opposition to the bill providing for a second bridge across the East River to connect this city with Brooklyn. The bill now before the legislature provides that the cost, estimated at $10,000,000, be borne equally by the two cities.

OGDENSBURG, N. Y.—The following bids were received April 12 for the construction of a steel plate girder bridge, as advertised in Engineering News; Engr., Chas. F. Stowell: Rochester Bridge & Iron Works, Rochester, N. Y., $50,900; Groton Bridge & Mfg. Co., Groton, N. Y., $48,883; Pittsburg Bridge Co., Pittsburg, Pa., $48,000; Detroit Bridge & Iron Wks., Detroit, Mich., $46,800; Elmira Bridge Co., Elmira, N. Y., $45,774; Wrought Iron Bridge Co., Canton, O., $45,000; Vermont Construction Co., St. Albans, Vt., $44,952; Toledo Bridge Co., Toledo, O., $44,915; Owego Bridge Co., Owego, N. Y., $44,600; Massillon Bridge Co., Massillon, O., $43,750; Pennsylvania Steel Co., Steelton, Pa., $41,600; King Bridge Co., Cleveland, O., $39,990; Hilton Bridge Const'n Co., Albany, N. Y., $39,000. For a stone arch bridge: Burns Bros., Watertown, N. Y., $54,950; Thomas Whalen, Ogdensburg, N. Y., $59,700; John B. Reilly, Trenton, N. J., $70,000. The Melan Arch Construction Co., of New York, presented two plans for a Melan arch bridge, at $31,700 and $34,850, respectively.

WARRENSBURG, N. Y.—The old bridge across the Schroon River at the county house has been condemned, and it is stated that an iron bridge with a single span of 144 ft. will be erected.

YONKERS, N. Y.—The council is reported as receiving bids for the construction of a bridge over Troublesome Brook on the Scarsdale Road.

NEWARK, N. J.—The Consolidated Traction Co. is trying to arrange with the Erie railway officials for the construction of a new bridge on Kearny Ave., Kearny, in place of the present one, which has been condemned.

TRENTON, N. J.—Bids are asked until April 23 for building an iron or steel bridge over Shabbakonk Creek, on the Lawrenceville road, in Lawrence township; also for stone abutments and wing walls for this bridge. N. H. Furman, Arch., 144 East State St.

ERIE, PA.—Arrangements have been made between the city and the Lake Shore & Michigan Southern and the Philadelphia & Erie (Pennsylvania) railway companies for depressing Ash St., in this city, where crossed by these roads. The subway will be 12 ft. high, with 20 ft. roadway and two 5-ft. sidewalks, and the railway tracks will be carried over it by 15 girder bridges 34 ft. 3 ins. in length. The city has appropriated $9,000 toward the work, which will cost about $30,000. It is intended to extend this improvement to all other north and south streets crossed by these tracks, which divide the city in halves. The original plans for the work were prepared by Geo. Platt, Cy. Engr., but the railway companies will have charge of the construction.

DUNBAR, PA.—The county commissioners are reported to have decided in favor of a new bridge over Dunbar Creek in this borough.

PITTSBURG, PA.—The county engineer has submitted the following estimates for county bridges for 1895: Thompson Run, $2,800; Moon Run, $3,000; Painter's Run, Scott township, $2,600; Kilbuck Run, $2,600; Lewis Run, $2,100; Pine Creek, McCandless township, $3,000; Chartiers Creek, Carnegie borough, $12,500; Campbell's Run, $3,000; Thompson's Run, $3,200; McLaughlin's Run, $3,300; Hurn's Run, $2,500; total, $40,600.

PITTSBURG, PA.—Wm. C. Jutte, H. H. Swaney and others arereported to have organized a company to build a bridge 3,000 ft. in length across the Youghiogheny River from Douglass station to Suterville.

SLATINGTON, PA.—It is reported that a new county bridge will be erected at Bowman's station at a cost of $50,000.

SUSQUEHANNA, PA.—On April 10, a part of the Susquehanna-Oakland iron bridge was carried away by high water.

CHESTERTOWN, MD.—Bids are asked until May 1 for constructing an iron or steel truss bridge across Price Creek in Kent county, according to reports. Address the county commissioners.

PORTSMOUTH, VA.—The Portsmouth Water Front Land Co. was organized April 8. The company has purchased 33 acres of water front property and will build a bridge across Scboos Creek. Pres., Henry Kirn; Secy., John L. Watson.

ATHENS, GA.—Bids will soon be asked for a new county bridge across the Oconee River, according to reports, the expense to be borne by Clarke and Oconee counties.

MERIDIAN, MISS.—Bids are asked until May 6 for building a bridge across the double branches, on the Toonizuba and Livingston road, near Graham's Crossing. B. V. White, Clk. Supervisors.

LOUISVILLE, KY.—Bids areasked by the board of public works until April 29 for an iron bridge across Beargrass Creek at Lampton St.

LONDON, O.—Clinton A. Bostwick and 147 others have petitioned for a joint county bridge over Deer Creek about one mile east of Mt. Sterling.

MASSILLON, O.—The board of trade is reported as urging the county commissioners to erect bridges across the canal and river at Columbian Heights.

VERSAILLES, IND.—Bids are asked until June 7 for the construction of a highway bridge over Laughery Creek, in Delaware township. Robt. R. White, Audr. Ripley County.

HOUGHTON, MICH.—Bids are asked until May 7 for the construction of a steel bridge across Portage Lake, between Hancock and Houghton. Engrs., the Osborn Co., Hickox Bldg., Cleveland, O.; Robt. H. Shields, County Clk.

CHICAGO, ILL.—The following bids were received last week for the superstructure of the Fullerton Ave. bridge, contract being awarded to the Chicago Bridge & Iron Co., and that for the substructure to Fitzsimons-O'Connell Co.: Lassig Bridge & Iron Works, Chicago, $12,000; C. L. Strobel, Chicago, $14,550; Mohn & Hoff, Chicago, $13,200; American Bridge Works, Chicago, $13,225; Chicago Bridge & Iron Co., Chicago, $11,694; Milwaukee Bridge Co., Milwaukee, Wis., $14,483; Edge Moor Bridge Co., Wilmington, Del., $19,865; Wrought Iron Bridge Co., Canton, O., $15,069; New Jersey Steel & Iron Co., Trenton, N. J., $15,350; Pittsburg Bridge Co., Pittsburg, Pa., $13,594.

GREEN BAY, WIS.—A bill introduced in the legislature granting authority to construct a bridge across East River in Green Bay is said to be in the interests of the Fox River Electric St. Ry. Co. The proposed structure will be a drawbridge.

KIELER, WIS.—Bids are asked until May 1 for the construction of a bridge 125 ft. long and 16 ft. wide across Platte River in Paris township. M. Kirchberg, Chn. Bd.

KANSAS CITY, MO.—Bids are asked until April 30 for the construction of an 80-ft. iron bridge over Brush Creek, on Prospect Ave. F. J. O'Flaherty, County Surv.

BROWNSVILLE, TEX.—An election will be held May 7 to vote on an issue of $50,000 in bonds for two iron bridges, improving county roads, etc.

DENVER, COLO.—A bill has passed second reading in the house appropriating $5,000 for a bridge across the Gunnison River, near Gunnison.

UKIAH, CAL.—Bids are asked until July 3 for the construction of two county bridges. John Flanagan, Chn. Supervisors.

WINNIPEG, MAN.—Bids are asked until May 23 for the erection of a steel superstructure for Osborne St. bridge. J. S. Sproule, Chn. Com.

BUILDINGS.

BOSTON, MASS.—Blackall & Newton have prepared plans for a new People's Temple, to be built on the site of the present structure, at Columbus Ave. and Berkeley St. The building is estimated to cost $650,000.

BUFFALO, N. Y.—W. H. Boughton has designed a new seven-story brick apartment house, to be constructed by the Imperial Apartment House Construction Co. at Edward and Franklin Sts. It will cost $75,000.

WASHINGTON, D. C.—Bids are asked until May 3 for the construction of a life-saving station, boat house, etc., at Gay Head, Mass., as stated in our advertising columns. S. I. Kimball, Gen. Supt., U. S. Life-Saving Service.—Bids are asked until May 15 for constructing a barrack and officers' quarters at Fort Myer, Va. Major C. R. Barnett, Q. M., U. S. A.

WINFIELD, W. VA.—Plans, specifications and estimates are asked until June 3 for remodeling and enlarging the Putnam county court house. Address R. A. Salmons.

ROCK HILL, S. C.—It is reported that plans will soon be prepared for a one-story brick mill, to contain one 50-HP. engine and turbine wheels, estimated to cost $50,000. Address John R. London.

ATLANTA, GA.—Bids are asked until April 26 for erecting four buildings for the Cotton States & International Exposition Co. Arch., Bradford L Gilbert, Tower Bldg., New York; Grant Wilkins, Ch. of Construction.

ZEBULON, GA.—Plans have been adopted for a court house, estimated to cost $30,000. Address W. H. Hartley.

CLEVELAND, O.—Bids are asked until May 11 for completing the erection of a 12-room school building on Sawinski St. H. J. Sargent, School Director, 190 Euclid Ave.

BRAZIL, IND.—The county commissioners have rejected all the bids for a new jail, and will readvertise the work.

RICHMOND, IND.—The legislature has appropriated $50,000 for additional buildings for the insane asylum at this place.

GRAND RAPIDS, MICH.—Bids are asked until May 2 for constructing a jail and house. Archs., H. C. Koch & Co.; G. L. Williams, Chn.

JEFFERSON CITY, MO.—Plans are asked by the board of regents of Lincoln Institute until April 27 for the rebuilding of the main building, which was destroyed by fire last August; estimated cost, $35,000.

SEDALIA, MO.—It is reported that the plans for the new $30,000 passenger station for the Missouri, Kansas & Texas R. R. Co. at this place have been approved, and that work on the construction will soon be commenced.

DECATUR, TEX.—Bids are asked until May 9 for erecting a courthouse. Arch., J. Riley Gordon, San Antonio; R. F. Spencer, Judge of Wise county.

EMPIRE CITY, ORE.—Bids are asked until May 15 for the purchase of $15,000 in 20-year 6% school bonds. We are informed that as soon as the bonds are sold a frame building will be erected with the proceeds. W. W. Hayes, Treas. Coos County.

PHOENIX, N. MEX.—Bids are asked until April 27 for erecting three buildings, etc. Harwood Hall, Supt. U. S. Industrial School.

TORONTO, ONT.—Bids are asked until April 22 for erecting a new printing house for the Globe Printing Co. Archs., Burke & Horwood.

WATER-WORKS.

NASHUA, N. H.—H. G. Holden, Supt., writes us that the contract for building dam No. 3 and appurtenances has been awarded to H. A. Fletcher & Co., the total bids being as follows:

H. E. Fletcher & Co., West Chelmsford, Mass.	$30,885
L. I. Taylor, Worcester, Mass.	31,300
W. P. Latham, Northampton, Mass.	31,500
R. D. Shannahan, Randolph, Mass.	31,550
John B. Riley, Newton, N. J.	33,127
Gennaro, Long & Little, So. Braintree, Mass.	34,360
Smith & McCormick, Easton, Pa.	35,270
Doherty & Berrigan, Yonkers, N. Y.	37,247
Bearse & Clifford, Lewiston, Me.	37,295
L. F. Kittredge, Lowell, Mass.	37,800
Trumbull & Ryan, Boston, Mass.	38,210
Allen & French, Worcester, Mass.	40,118
McNiece, Cuozzo & Co., New York	41,137
Ward & Douglas, Barre, Vt.	41,193
Wm. S. Marsh, Lawrence, Mass.	41,989
James Dorman, Lawrence, Mass.	42,000
Conners Bros., Lowell, Mass.	45,554

NEW HAMPTON, N. H.—There is talk of constructing works in this village.

PORTSMOUTH, N. H.—Local papers state that Josiah Chase, L. M. Webb, W. R. Howard and others will meet May 7 to organize the York Shore Water Co., with a capital stock of $100,000.

BANGOR, ME.—The superintendent has been authorized to ask for bids for 6,000 ft. of 6-in. pipe.

DAMARISCOTTA, ME.—It is stated that the question of works will soon be decided at a special election.

YARMOUTH, ME.—We are informed that the supply for the proposed works will be from springs and pumped to a stand-pipe; estimated cost, $40,000; population, 2,000. Chn. Com., Geo. W. Hammond; Frank Bucknam, Town Clk.

BROOKLINE, MASS.—The town has appropriated $21,480 for extensions.

NATICK, MASS.—The water commissioners have been authorized to borrow $2,000 for extending the water main on Woodland St.

BRISTOL, R. I.—A special town meeting will be held April 27 to consider the purchase of the works.

WESTERLY, R. I.—At a special town meeting April 11 the town council was directed to construct new works, at a cost not to exceed $150,000, unless a satisfactory arrangement can be made with the Westerly Water-Works Co. within 30 days.

SOUTHPORT, CONN.—The Southport Water Co. is reported about to commence the construction of works, and it is stated that the company will be able to supply this place and Fairfield by September.

WILLIMANTIC, CONN.—The contract for building the new pumping station has been awarded to the Wheaton Building & Lumber Co., of Putnam, at $6,948 or $6,250, according to the foundation.

BINGHAMTON, N. Y.—A public hearing was held April 15 to discuss the bill authorizing this city to issue $250,000 in bonds for a new pumping station and reservoir.

BOONVILLE, N. Y.—Efforts are being made to secure the construction of works in this village.

FORESTVILLE, N. Y.—E. A. Curtis, of Fredonia, is preparing plans for the proposed works.

GREENPORT, N. Y.—A special election was held April 17 to vote on the purchase of the works.

FLUSHING, N. Y.—G. A. Roullier, Engr., has reported in favor of a 30 × 120-ft. stand-pipe, estimated to cost, complete, $32,000.

FREDONIA, N. Y.—A bill has been introduced in the legislature authorizing this village to issue $[illegible],000 in bonds to enlarge the works.

MOUNT MORRIS, N. Y.—The Murray Hydraulic Co., noted last week, has been granted a franchise. Pres., Norman A. Seymour.

NIAGARA FALLS, N. Y.—The Cataract Construction Co. is reported to have contracted for a $60,000 filter plant.

PAINTED POST, N. Y.—A committee has been appointed to investigate the advisability of constructing works.

PALMYRA, N. Y.—It is reported that the contract with the water company has expired, and that there is talk of buying the works.

RHINEBECK, N. Y.—It is reported that an election will soon be held to vote on the question of works.

SAUGERTIES, N. Y.—The taxpayers are reported to have voted almost unanimously to build new works, estimated to cost $60,000 to $80,000.

SCHENECTADY, N. Y.—Bids are asked by the city treasurer until May 15 for the purchase of $215,000 in water bonds, recently authorized for a new supply. It is expected that bids will soon be asked for wells, galleries and pipelaying, to be followed as soon as possible thereafter by bids for pumping station, water tower, etc. Lewis B. Sebring, Cy. Engr.

LONGPORT, N. J.—The Longport Water & Light Co. was incorporated April 10, with a capital stock of $25,000, commencing with $4,000; incorporators, M. S. McCullough, W. W. Sanborn, of Longport; J. P. Remington, of Philadelphia, and others.

MOUNT EPHRAIM, N. J.—The Central Water Co. was incorporated April 12, with a capital stock of $100,000, to construct works in Center township, Camden county; incorporators, S. A. Bacon, John Hutchinson, E. T. Gill, Edwin R. Bell, and others, all of Camden county, N. J.

PRINCETON, N. J.—The Princeton Water Co. has contracted with Acock & Son, of Trenton, to extend its water mains in seven streets.

HARRISBURG, PA.—H. T. Duke, 510 North 39th St., Philadelphia, is treasurer of the following companies, incorporated April 15, each with a capital stock of $5,000, commencing with $500: New Cumberland Water Co., to supply New Cumberland; East Harrisburg Water Co., to supply the village of East End, Swatara township; Cumberland Water Co., to supply Boiling Springs borough and the township of South Middleton; Camp Hill Water Co., to supply Camp Hill.

ALTOONA, PA.—Bids are asked until May 1 for constructing a flood water channel at Kittanning Point, as stated in our advertising columns. C. A. Martin, Secy. Comrs.

MEADVILLE, PA.—We are informed that a large number of bids were received for the construction of new works, the lowest being at about $105,000 for the complete plant. No contract has yet been awarded.

MONACA, PA.—An election will be held May 14 to vote on an issue of $30,000 in bonds for works.

MOUNT HOLLY SPRINGS, PA.—The Mount Holly Water Co. was incorporated April 12, with a capital stock of $5,000, commencing with $500, to supply water at Mount Holly Springs. Treas., E. S. Whitney, Allentown, Pa.

PHILADELPHIA, PA.—Joseph Wharton, in an address before the New Century Club, April 10, outlined a scheme for bringing water from the southern part of New Jersey to supply this city and Camden, the cost for a daily supply of 300,000,000 gallons being estimated at $15,000,000.

QUAKERTOWN, PA.—The council is reported to have contracted for 45 fire plugs at a rental of $12.50 per month. It is stated that the company holding the franchise will construct a reservoir and lay pipes through the borough at an early date.

SUSQUEHANNA, PA.—The Susquehanna Water Co. is reported as taking steps to construct a large storage reservoir.

WASHINGTON, PA.—Plans for a dam 30 ft. high

for a storage reservoir for the Citizens' Water-Works Co. have been prepared by John G. Ruple, Engr., and it is stated that the construction will be commenced at once. It is proposed to build a 16-ft. driveway about 7,000 ft. long around the new reservoir.

SHENANDOAH, VA.—The mayor writes us that a franchise has been granted to the Milnes Water Co., but that the company, for some unknown reason, is slow in taking steps to construct works. If the matter could be taken out of the company's hands, it is probable that works would be put in at an early date; population, 2,000.

ATLANTA, GA.—A committee has visited Athens, Ga., to inspect the filters at that place, and it is reported that a similar system will be recommended for adoption here.——The council is considering an ordinance providing for an election to vote on an issue of $100,000 in bonds for extensions.

FERNANDINA, FLA.—The board of public works has recommended the construction of an additional storage reservoir. G. Stark, Chn.

COAHOMA, MISS.—The Memphis Well Co. has sunk a well 480 ft. deep for the Yazoo & Mississippi Valley R. R. Co., the supply rising to within 11 ft. of the surface.

SCRANTON, MISS.—S. R. Thompson is a member of the committee appointed to secure bids for the construction of works.

FRANKFORT, KY.—Local papers are discussing the desirability of procuring a filter plant.

LOUISVILLE, KY.—The water company is reported to have contracted with the O. H. Jewell Filter Co. for a filter plant, to be put in on trial.

MONTPELIER, O.—C. D. Hall, Clk., writes us that the citizens voted over 5 to 1 to issue bonds for works, but that no other steps have yet been taken; population, 2,000.

HAGERSTOWN, IND.—It is stated that works will be put in this summer.

SOUTH WHITLEY, IND.—Bids are asked until April 22 for the construction of works. M. W. Webster, Pres. Bd.

HOLLAND, MICH.—Bids are asked until April 22 for a 1,500,000-gallon pumping engine. Geo. H. Sipp, Clk.

CHICAGO, ILL.—Bids are asked until April 23 for the Union Park water system, Garfield Park water system and the Douglas boulevard service pipes. Geo. F. Talty, Secy. West Chicago Park Comrs.——Bids are asked until April 24 for laying water service pipes in 14 streets. W. D. Kent, Comr. Pub. Wks.

KNOXVILLE, ILL.—L. M. Smith, Cy. Clk., writes us that the following bids were received for pumping machinery, as advertised in Engineering News:

Vertical and duplex pumps.

Knowles Steam Pump Wks., Chicago, Ill.	$1,637
Barr Pumping Engine Co., Chicago, Ill.	1,170

Vertical deep well pump.

Downie Pump Co., Valencia, Pa.	$890
American Well Works, Aurora, Ill.	850

Duplex fire pump.

Gardner Governor Co., Quincy, Ill.	$489
Frost Mfg. Co., Galesburg, Ill.	650
Deane Steam Pump Co., Chicago, Ill.	569
Rumsey & Sikemeier Co., St. Louis, Mo.	490
Stilwell-Bierce & Smith-Vaile Co., Chicago, Ill.	640
L. M. Rumsey, St. Louis, Mo.	539
American Well Works, Aurora, Ill.	487

MURPHYSBORO, ILL.—The Murphysboro Water-Works & Electric & Gas Light Co. has increased its capital stock from $60,000 to $80,000.

SHEFFIELD, ILL.—It is reported that bonds will be issued for works.

GRANTSBURG, WIS.—Bids are asked until May 1 for constructing works, according to press reports. A. A. Anderson, Clk.

INDEPENDENCE, WIS.—This village is reported to have issued $3,000 in bonds for works.

MINNEAPOLIS, MINN.—Bids are asked until April 29 for the purchase of $200,000 in 4% bonds, and until April 30 for a supply of valves, pipe, special castings and for the construction of a reservoir. Chas. F. Haney, Cy. Clk.

COLUMBUS JUNCTION, IA.—C. M. Fulton, Mayor, writes us that an election will be held May 13 to vote upon bonding the town for works. No other steps will be taken until after the election.

DUBUQUE, IA.—Peter Kiene and F. W. Altman are reported as proposing to construct works to supply the Park Hill district.

MALCOM, IA.—The citizens are reported to have voted to issue $4,600 in bonds for works.

SIGOURNEY, IA.—The council has voted to sink a test well. If this proves successful, it is stated that it will save the town $5,000 a year.

HASTINGS, NEB.—The council is considering the purchase of new pumps.

CHEROKEE, KAN.—The citizens have voted to issue $15,000 in bonds for works.

MOORHEAD, N. DAK.—A petition is being circulated to secure a municipal water-works and electric light plant.

GLASGOW, MONT.—The Glasgow Water & Light Co. has been incorporated to construct water-works and electric light plants; capital stock, $25,000; Pres., Chas. E. Hall; Secy., A. W. Mahon, C. E.

ALVARADO, TEX.—The Alvarado Water Supply & Electric Co. has been organized, and over $10,000 worth of stock subscribed; directors, M. Sansom, H. R. Jones, T. B. Pope, E. P. Reynolds and others.

BIG SPRINGS, TEX.—The Big Springs Water-Works Co. has been incorporated, and is reported to have purchased materials for works.

BLOOMING GROVE, TEX.—Over $3,000 has been subscribed towards securing an artesian well.

GOLIAD, TEX.—A company has been incorporated to put in works, but H. B. Campbell, Treas., writes us that a franchise has not yet been secured from the city, and that no stock has yet been subscribed.

LANCASTER, TEX.—A press report states that $10,000 is being raised to bore an artesian well and construct works, of which about one-half has been subscribed.

MOODY, TEX.—J. C. Reynolds, owner of the works, writes us that several thousand feet of pipe will probably be needed in a few days.

GUTHRIE, OKLA.—Geo. M. De Goff, Cy. Clk., writes us that $5,000 in bonds have been voted for improving the works. H. C. Barney, Chn. Com.

ANTELOPE, ORE.—The Antelope Water Co. has been incorporated; capital stock, $100,000; incorporators, N. R. Baird, W. B. Bolton, C. B. Durbin.

KLAMATH FALLS, ORE.—At a mass meeting April 4 the citizens voted unanimously to petition the trustees to issue $10,000 in bonds for works and an electric light plant.

SOUTH RIVERSIDE, CAL.—The Caljalco Water Co. was incorporated April 11, with a capital stock of $500,000, commencing with $1,000; incorporators, H. L. Blumdell, of Riverside; J. C. Gleason, E. W. Freeman and others, of South Riverside.

GALLUP, N. MEX.—The residents of this place are reported as agitating the question of building a large reservoir three miles above the town to secure a water supply for domestic and irrigation purposes.

IRRIGATION.

RUSSELL, KAN.—Bids are asked by the state board of irrigation, at Topeka, until May 1 for constructing a pumping station, which is to include a well, power, pump and reservoir. W. B. Sutton, Secy., Russell; M. B. Tomblin, Comr., Goodland.

TOPEKA, KAN.—Press reports state that the state board of irrigation has located three more pumping stations—one in Greeley county, one in Lane county and one in Wichita county. Eleven pumping stations have now been located. There will be 14 in all. The board has decided to use gasoline power for the engines at Goodland and Oakley.

ULYSSES, KAN.—Bids are asked until May 1 for constructing a pumping station. W. B. Sutton, Secy. State Bd. of Irrigation, Russell; D. M. Frost, Comr., Garden City.

HOT SPRINGS, S. DAK.—The citizens of Fall River county are considering the question of forming an organization for irrigation purposes in the Black Hills. S. E. Wilson, C. V. Gardner, of Piedmont, and C. B. Boyle are interested.

CHEYENNE, WYO.—Press reports state that there is every indication that a number of large irrigation enterprises will be started in Wyoming during the coming summer. Capitalists appear to be ready to advance money to construct irrigating works under the provisions of the law passed by the last legislature, accepting the million-acre donation from the government. State Engineer Mead has been summoned to Omaha to consult with the officers of the Shoshone Land & Irrigation Co., of which Col. W. F. Cody is at the head, in reference to the construction of large irrigation works on the Shoshone River in the Big Horn basin, in the northern part of Wyoming. The company was recently organized with a capital stock of $2,000,000. Application was made to the state land board for a permit to construct the irrigation works, and the board instructed the state engineer to examine the plans and specifications for the same and report as soon as practicable. The irrigation company has engaged a corps of engineers.

PORTLAND, ORE.—Bids are asked until June 15 for constructing nine miles of irrigating canals, approximately 50,000 cu. yds. earth and 3,000 cu. yds. of rock excavation. The contract was to have been awarded March 27, but we are informed that the work will be readvertised. Geo. W. McCoy, Secy., 284 Morrison St.

SANTA FE, N. MEX.—Press reports state that work on the Santa Fe Water & Improvement Co.'s second storage reservoir was commenced April 8. The foundation for the dam was laid last fall. The work at present in hand consists of running a tunnel 6 ft. square and 240 ft. in length along under the Weltmer hill. This tunnel will serve as a spillway during the time the building of the dam is in progress, and when this is finished the tunnel will be used as a gateway leading to a network of ditches and pipes which will convey the water for irrigation purposes out into the Santa Fe valley. Work on the dam will begin within 30 days. It will be constructed by hydraulic process, as originally planned by Engineer Howells.

PHOENIX, ARIZ.—It is reported that work has been commenced upon the Rio Verde canal and storage reservoir, estimated to cost $2,000,000.

PROVO, UTAH.—It is stated that the property of the Starr Irrigation Co. has been purchased by the Mount Nebo Irrigation Co., which will complete the work. G. S. Peyton and E. G. Rognon are interested.

NEW COMPANIES.—Uintah Mountain Steam Irrigation Co., Uintah, Weber county, Utah; $5,600.

Underflow Irrigation Co., Topeka, Kan.; $1,000,000; C. S. Gleed, E. F. Ware, D. E. Palmer, C. H. Hamilton, Topeka.

Merrick County Canal Co., Clarks, Neb.; $150,000; Orlando Nelson, Clayton A. Gates, Ira E. Gates, Ethel A. Richardson.

Loveland Pipe Line Co., Loveland, Colo.; to convey water for irrigation purposes, etc.; Wm. W. Sullivan, J. M. Puntney, W. J. Puntney.

Montana Irrigation & Land Co., Glasgow, Mont.; $200,000; Pres., J. L. Truscot; Secy., M. D. Hoyt; Treas., Frank Lemmer; Ch. Engr., A. W. Mahon.

Southern California Investors' Excursion Co., San Diego, Cal.; $100,000, with $1,300 paid in; to improve reservoirs canals, pumping machinery, etc.; James A. Gibson, Moses A. Luce, Daniel Schuyler, San Diego; Frank E. Brown, Redands; Robert Somerville, Riverside, Ill.

SEWERAGE.

HENNIKER, N. H.—It is reported that this place has voted to issue $19,000 in bonds for completing the system recently begun.

BROCKTON, MASS.—The council has voted to issue $175,000 in bonds for extending the system this year. F. Herbert Snow, Cy. Engr.

BROOKLINE, MASS.—Alexis H. French, Town Engr., writes us that at a town meeting held April 11 an appropriation of $30,000 was made for general construction and one of $14,500 for surface water drains. It is expected that an additional appropriation of $40,000 will be made at a future town meeting for other storm water sewers.

JAMAICA PLAIN, MASS.—It is proposed to appropriate $20,033 for constructing an outlet sewer.

NEW BEDFORD, MASS.—The board of public works has petitioned for an appropriation of $15,000 for a sewer in Coffin St.

WEBSTER, MASS.—John Flint, L. R. Eddy and E. N. Bigelow have been appointed a committee to report on the advisability of constructing a system.

AVON, N. Y.—The commissioners have estimated the cost of a system at about $12,000.

BROOKLYN, N. Y.—Bids are asked until April 20 for replacing a wooden trunk sewer in Ferry Place; and until April 26 for constructing sewers in seven streets, as stated in our advertising columns. A. T. White, Comr. Cy. Wks.

ROCHESTER, N. Y.—The committee has recommended the construction of a tunnel to carry the sewage of North Water St. and Central Ave., and also an outlet sewer in Meigs St.

ROCHESTER, N. Y.—The following bids were received April 7 for constructing the Court and William St. outlet sewer, estimated to cost $19,000: Thomas F. Moore, of Buffalo, $12,653; Bruff & Co., $14,503; Chambers & Casey, $14,518; Thomas Grady, $15,988; H. N. Cowles, $15,948; William Fuller, $15,986; H. L. & F. W. Jones, $16,300; Lauer & Hagaman, $16,705; Whitmore, Rauber & Vicinus, $16,997.

RHINEBECK, N. Y.—It is reported that the question of constructing sewers and water-works will soon be voted upon by the taxpayers.

YONKERS, N. Y.—Bids are asked until May 13 for constructing a sewer in Webster Ave.——The construction of a sewer in High St. is being considered.

ATLANTIC CITY, N. J.—The Beach Sewerage & Improvement Co. has petitioned for a franchise to construct a system in a suburb of this city known as Chelsea. Secy., E. Wood.

NEWARK, N. J.—The committee has recommended the construction of a system in the northwestern portion of the city, and another system in the section of the city known as Woodside.——The board of public works has been petitioned to construct sewers in two streets.

TRENTON, N. J.—Bids are asked until April 23 for constructing sewers in three streets. C. E. Murray, Cy. Clk.

WESTFIELD, N. J.—We are informed that the following bids were received April 9 for constructing sewers: Laterals, Stratford & Hawkes, Brooklyn, N. Y., $24,234; Edward Gorman & Co., New York, $28,464; John Marsden, Utica, N. Y., $26,475; P. H. Harrison & Sons, Newark, N. J., $25,935; trunk sewers, John Marsden, line A, $14,888, line B, $15,628; P. H. Harrison & Sons, $15,173, $16,153; Stratford & Hawkes, $20,761, $21,619. The itemized bids will probably be published next week. Engr., F. A. Dunham, Plainfield, N. J.

JOHNSTOWN, PA.—The construction of a sewer in the Eighth ward is being considered.

ELKTON, MD.—It is reported that the question of issuing bonds for a system and for repairing streets is being considered.

KENSINGTON, MD.—The committee is considering a proposition from B. H. Warner for the lease of three acres of land for sewage disposal without polluting Rock Creek. The council will be asked to hold an election to vote on the question of issuing $5,000 in bonds for the work.

CINCINNATI, O.—Plans have been prepared for sewers in four streets. A. P. Butterfield, Clk. Bd. Administration.

INDIANAPOLIS, IND.—Bids are asked until April 25 for constructing 468 ft. of 10 and 6-in. pipe sewers and house connections.——Resolutions have been adopted for 8,061 ft. of sewers, varying in size from 48 × 32-in. brick to 8-in. pipe, and for 967 ft. of 15-in. pipe sewers in two streets. Chas. C. Brown, Cy. Engr.

LAFAYETTE, IND.—W. K. Eldridge, Cy. Engr., informs us that the following bids were received April 8 for constructing 1,625 ft. of 120 and 94-in. brick sewers in Greenbush St.:

G. W. Snyder, Lafayette (awarded contract)	$20,817
John D. Richardson, Lafayette, Ind.	20,938
Joshua Chew, Lafayette, Ind.	21,384
Mansfield & Allen, Indianapolis, Ind.	22,682
McCarthy & Sager, Cleveland, O.	23,311
Jesse Robertson, Terre Haute, Ind.	31,853

ADRIAN, MICH.—The mayor has recommended the construction of a system.

PEORIA, ILL.—Walter C. Parmley, First Asst. Engr., informs us that the following bids were received April 11 for constructing the West Bluff systme, as advertised in Engineering News; the itemized bids will probably be published next week:

James Deal & Co., Peoria, Ill.	$277,506
T. B. Townsend Co., Zanesville, O.	311,195
Wilson & Jackson, Chicago, Ill.	315,642
Geo. S. Miller & Co., Ottawa, Ill.	316,248
Penney-Myers Construction Co., St. Louis, Mo.	319,625
F. W. Kinser & Sons, Terre Haute, Ind.	320,960
Campbell, Dennis & Co., Joliet, Ill.	322,000
Fruin-Bambrick Const'n Co., St. Louis, Mo.	324,764
Wilson & Strack, Cincinnati, O.	341,093
W. J. Gawne, Cleveland, O.	349,262
Shailer & Schnigiau Co., Chicago, Ill.	353,028
James Roche & Co., Chicago, Ill.	359,006
N. F. Reichart & Co., Racine, Wis.	360,873
Rockford Construction Co., Rockford, Ill.	368,528
James Cape & Sons, Racine, Wis.	376,910
Mason, Hoge & Co., Romeo, Ill.	377,747
Gantz, Kinnear & Co., Columbus, O.	378,636

ST. LOUIS, MO.—Bids are asked by the board of public improvements until April 26 for constructing 6,495 ft. of 24 to 12-in. pipe sewers and 1,880 ft. of 36 × 24-in. brick sewers.

DES MOINES, IA.—The council has passed a resolution for the construction of an 84-in. sewer in Birds Run, from the river to 11th St., a distance of 2,938 ft., estimated to cost about $30,000.

GRINNELL, IA.—Chas. P. Chase, who was noted in our issue of April 4 as preparing plans for a system of sewers at this place, is manager of the Iowa Engineering & Construction Co., Clinton, Ia., and this company is preparing the plans.

BARRIE, ONT.—Bids are asked until May 2 for

constructing 2,800 ft. of 9-in. pipe sewers in three streets. Henry Bird, Town Clk.

GARBAGE DISPOSAL.

TRENTON, N. J.—The board of health was authorized about two years ago to spend $8,000 for a garbage crematory, but the selection of a proper site has not yet been settled. It is reported probable, however, that the preliminaries will all be arranged satisfactorily within a few weeks.

READING, PA.—The mayor has signed a resolution asking the board of health to prepare plans for a garbage crematory, as recently recommended by a special committee. It is hoped to have the project carried out this year.

INDIANAPOLIS, IND.—The American Reduction Co. is reported to have made a proposition to this city whereby the garbage will be collected and disposed of without cost to the city.

CHICAGO, ILL.—J. W. Twohig, Secy. Dept. Pub. Wks., writes us that the following contracts have been awarded for the removal of garbage and ashes in this city from April 1 to Dec. 31:

Ward.	Contractor.	Amount.
1	John S. Cooper	$16,000
2	Ryan & Nelligan	11,040
3	Ryan & Nelligan	10,000
4	Hanson & Mathieson	12,500
5	J. E. McDonough	5,000
6	J. E. McDonough	3,550
7	H. P. Carmody	5,701
8	L. G. Wolfersheim	4,600
9	J. A. O'Connell	5,000
10	H. Curran	3,800
11	John Cullerton	9,500
12	John H. Nolan	11,364
13	John Dowdle	9,200
14	John Dowdle	5,595
15	E. N. Hurley	3,550
16	S. Ryan	6,400
17	S. Ryan	5,478
18	J. Shannon	8,297
19	J. Bradley	10,000
20	James Dempsey	2,750
21	Fred Luth	6,820
22	Patrick Mulcare	4,935
23	M. Doyle	5,900
24	J. S. Cooper	12,500
25	J. Dempsey	5,500
26	J. Dempsey	3,825
27	M. Maher	1,900
28	E. Hurley	2,023
29	M. Harrington	6,500
30	M. Harrington	8,600
31	J. E. McDonough	5,000
32	J. S. Flynn	14,442
33	J. S. Flynn	3,744
34	F. H. Teeple	9,000

STREETS AND ROADS.

LOWELL, MASS.—A state highway 50 ft. in width with a 30-ft. roadway, is to be built from Lowell to North Chelmsford.

NEWPORT, R. I.—Bids are asked until April 29 for the purchase of $100,000 in 30-year 4% bonds for public improvements. Wm. G. Stevens, Cy. Clk.

PROVIDENCE, R. I.—The commissioner of public works has been authorized to grade, pave, etc., portions of 31 streets.——The council has voted to pave Broadway with Trinidad Lake asphalt, at an estimated cost of about $70,000.

FLUSHING, N. Y.—A bill has been introduced in the legislature authorizing an issue of $100,000 in bonds for macadamizing certain streets. George Popple, Joseph Oppenheimer and G. J. Merritt, Comrs.

NEW YORK, N. Y.—Bids are asked until May 1 for constructing a road, etc., crossing the east branch of reservoir D in the town of Kent. Edward L. Allen, Secy. Aqueduct Comrs.

SYRACUSE, N. Y.—Henry C. Allen, Cy. Engr., has prepared plans for paving over a mile of Butternut St. with asphalt or brick.

JERSEY CITY, N. J.—The following bids have been received for grading the new boulevard extension, which extends from 19th St., Weehawken, to the Bergen county line, the contracts being divided into two sections: Section 1, 2½ miles in length: Gallery & Murphy, $98,466; F. C. O'Reilly, $100,601; P. L. Rehill, $79,763; Henry & McGibney, $96,028; Bernard Feeney, $94,963; Michael J. Curley, $73,615; Holmes & Coogan, $107,757; Patrick H. Flaherty, Jr., & Co., $104,745. Section 2, 2 miles: Pennell & O'Hearn, $62,633; F. C. O'Reilly, $79,339; Bernard Feeney, $73,278; Henry & McGibney, $73,367; Michael J. Curley, $59,785; Holmes & Coogan, $83,700; Hudson County Contracting Co., $73,245.

NEWARK, N. J.—It is proposed to pave portions of four streets with granite blocks on a concrete foundation.

TRENTON, N. J.—Bids are asked until April 23 for paving two streets with brick. C. E. Murray, Cy. Clk.

PHILADELPHIA, PA.—Bids are asked until April 26 for repaving several streets and grading two others. Thomas M. Thompson, Dir. Pub. Wks.

WILMINGTON, DEL.—Bids are asked until April 23 for furnishing curbstones, granite, cement, sewer supplies, etc., until April 1, 1896, and for improving the pavements of such streets as needed during that time. H. J. Wiley, Dir. St. Dept.

ANNAPOLIS, MD.—Bids are asked until April 25 for grading and paving portions of three streets. F. M. Ramsay, Ch. Bureau of Navigation, Washington, D. C.

BALTIMORE, MD.—Bids are asked until April 22 for furnishing about 140,000 Belgian blocks and 2,000 cu. yds. of sand. A. E. Smyrk, Cy. Comr.

LAUREL, MD.—Bids are asked until April 22 for grading, macadamizing, curbing, etc., Washington Ave. J. W. Gray, Clk. Council.

CLEVELAND, O.—The following bids have been received for paving Center and Merwin Sts., respectively:

N. O. Paving & Const'n Co.	$16,600	$25,501
Shields & Lauer	18,379	28,606
M. F. Bramley	17,949	27,350
Albion Stone Co.	18,162	27,710
L. & J. F. Brennan	18,761	28,546
R. P. Burnett	19,148	29,259

——The park commissioners have awarded the contract for constructing a section of the Doan Brook Boulevard to the North Ohio Construction Co.

CINCINNATI, O.—Bids are asked by the board of administration until April 30 for paving five streets with brick.

INDIANAPOLIS, IND.—Resolutions have been adopted by the board of public works for paving 1,970 lin. ft. with asphalt, and 3,700 lin. ft. with brick.——Plans have been ordered for 24,000 lin. ft. of asphalt paving and 4,500 lin. ft. of brick paving. Chas. C. Brown, Cy. Engr.

TIPTON, IND.—Bids are asked until April 30 for constructing brick pavements in four streets, 12,267 sq. yds., and brick and cement sidewalks, as stated in our advertising columns. L. Vernon Gould, Cy. Engr.; L. B. Nash, Mayor.

ADRIAN, MICH.—The mayor has recommended that a proposition to issue $80,000 in bonds for paving be submitted to the voters next spring.

ALTON, ILL.—The council has made arrangements with the C., C., C. & St. L. R. R. Co. for freight yards in the East End, by which the company agrees to spend $40,000 in paving and other improvements.

MILWAUKEE, WIS.—A bill has passed the state senate authorizing the board of public works to pave Grand Ave. with asphalt.

DAVENPORT, IA.—The Edwards & Walsh Construction Co. has been awarded a contract for paving several streets with brick, at $55,905, and the Flick & Johnson Construction Co. for paving three streets with brick, at $10,229.

DES MOINES, IA.—The board of public works has been directed to advertise for bids for paving 11 streets with brick.

DUBUQUE, IA.—Bids are asked until April 24 for 30,000 sq. yds. of brick paving, 9,000 lin. ft. of curbing, etc. T. J. Cooney, Cy. Recdr.

SIOUX CITY, IA.—The paving of Fourth St. with asphalt, granite, or brick, is being discussed.

ST. PAUL, MINN.—The board of public works has voted to pave St. Peter's St. with asphalt and cedar blocks.

ST. LOUIS, MO.—Bids are asked by the board of public improvements until April 26 for improving 14 streets.

KANSAS CITY, MO.—Bids are asked until April 30 for grading and macadamizing about 3¼ miles of roads, and bids are asked until May 2 for macadamizing about three miles of the Croysdale road and grading portions of two other roads in Jackson county. F. J. O'Flaherty, County Surv.

BARRIE, ONT.—Bids are asked until May 2 for constructing 2,000 lin. ft. of concrete sidewalk and for 1,600 lin. ft. of Telford paving. Henry Bird, Town Clk.

MISCELLANEOUS CONTRACTS AND SUPPLIES.

BOULEVARD LAMPS.—Chicago, Ill.—Bids are asked by the West Chicago park commissioners until April 23 for furnishing 333 boulevard lamps.

DREDGING.—Detroit, Mich.—Bids are asked until May 2 for dredging, as stated in our advertising columns. Lieut.-Col. G. J. Lydecker, U. S. Engr. Office.

COAL.—Wilmington, N. C.—Bids are asked until May 14 for 1,000 to 1,100 tons of coal, as stated in our advertising columns. Maj. W. S. Stanton, U. S. Engr. Office.

LEVEE WORK.—Rock Island, Ill.—Bids will be received at the U. S. Engr. Office until May 14 for 600,000 cubic yards of levee work, as stated in our advertising columns.

DREDGING.—Montgomery, Ala.—Bids are asked until May 21 for dredging in Apalachicola Bay, Fla., as stated in our advertising columns. Maj. F. A. Mahan, U. S. Engr. Office.

STEEL.—Washington, D. C.—Bids are asked until April 30 for a quantity of steel plates and steel angles for the Mare Island navy yard. Edwin Stewart, Paymaster General, U. S. N.

STONE.—Pittsburg, Pa.—Bids are asked until May 11 for 284 cubic yards of stone for lock in the Allegheny River, at Pittsburg, as stated in our advertising columns. Maj. R. L. Hoxie, U. S. Engr. Office.

ROUNDHOUSE, ETC.—Winslow, Ariz.—Press reports state that the roundhouse and machine shops of the Atlantic & Pacific R. R. at this place have been destroyed by fire, burning several locomotives and causing a loss of $100,000.

COMPLETING DRY DOCK.—Brooklyn, N. Y.—Bids are asked until April 29 for completing the construction of a timber dry dock, 670 ft. long, at the Brooklyn navy yard. Address E. O. Matthews, Chief of Bureau of Yards and Docks, Washington, D. C.

DRAINAGE DITCH.—Decatur, Ill.—The "Despatch" of this city states that the preliminaries have been completed for the construction of a drainage ditch five miles long and estimated to cost $15,000, to drain 1,500 acres of land in the south part of Logan county.

RIVER IMPROVEMENTS.—Washington, D. C.—The secretary of war has approved the project submitted by the Mississippi River commission for the improvement of that river from the head of the passes to the mouth of the Ohio River, under an appropriation of March 2, 1895, of $2,665,000, and increased $8,000 by unallotted appropriations of 1894. The remaining unexpended appropriations are as follows: First and second districts, lower St. Francis, $88,000; upper Yazoo, $100,000; upper White, $53,000; lower White, $75,000; lower Yazoo, $150,000; upper Tensas, $300,000; middle Tensas, $100,000. Fourth district, lower Tensas, $132,000; Atchafalaya, $152,000; Lafourche, $90,000; Barataria, $60,000; Ponchartrain, $150,000; Lake Borgne, $50,000. Construction and river repairs, first and second districts—Restoration of old work at Daniel's point, $60,000; new construction above Daniel's point, $130,000; new construction of Osceola bar, $78,750; purchase of new tow boat, $30,000.

STREET SWEEPING MACHINE.—Easton, Pa.—H. R. Fehr, Cy. Engr., writes us that the following bids were received April 12 for furnishing the city with one pick-up street sweeping machine: Julian Scholl & Co., Kelly sweeper, $650, f. o. b. cars Easton; P. H. Richards, International sweeper, $750, f. o. b. cars Easton, O.

IMPROVING NEW LAND.—Brooklyn, N. Y.—Plans are being considered for improving land recently acquired by the city at Wallabout. The property is 500 ft. wide, and has a frontage of 1,700 ft. on Washington Ave. It is proposed to make provision for two transfer bridges, three piers, and two car yards, with a capacity for 300 to 400 cars.

RIVER IMPROVEMENTS.—Orange, Tex.—A press report states as follows: Lilies & Allardyce have secured the contract for clearing obstructions from the Sabine River, and as soon as the spring trade is over the steamboat "Neches Belle" will be fitted up with snag lifters, put to work and kept at it until the present appropriation of $5,000 is exhausted. The work will be under the personal supervision of a government inspector appointed by Maj. James B. Quinn.

CONTRACT PRICES.

CAST IRON PIPE.—Albany, N. Y.—The water board has awarded a contract for 800 tons of cast iron water pipe to the Warren Foundry & Machine Co., at $19.70 per ton. The bids for special castings ranged from 1⅞ cts. to 2¼ cts. per lb.

BRICK PAVING.—Davenport, Ia.—E. W. Boynton, Comr. Pub. Wks., writes us that the contracts for the brick paving recently noted have been awarded to the Edwards & Walsh Construction Co. and the Flick & Johnson Construction Co., both of Davenport, at $1.27 per sq. yd. with concrete foundation and $1.05 and 99 cts. with macadam foundation.

BRICK AND ASPHALT PAVING.—Houston, Tex.—The following bids were received April 8 for paving Willow, Liberty, McKee and Pontl Sts., and Odin Ave.:

Items.	Houston Construction Co.	Colorado Paving Co.	Claus Vierhus.	Litho-Carbon Rubber Co.
Resett'g old curb walls, per M. brick	$15.00	$10.00	$1.00	$7.00
4 x 20-in. stone curbing, per lin. ft.	.55	.45	.50	.50
5 x 20-in. " " "	.60	.55	.65	.64
Brick curbing, per M. brick	17.00	13.00	13.50	13.50
Hard-burned brick gutters, lin. ft.	.70	.30	.32	.30
Vit. paving brick gutters, per lin. ft.	.90	.35	.35	.35
Asphalt pavement, Class A, sq. yd.	.....	2.21[1]	2.26	2.25
" " " B, " "	.....	2.11[2]	2.20	2.20
" " " C, " "	.....	2.01[3]	2.18	2.15
" " " D, " "	.....	1.89	2.00	1.80
Cast iron culvert covers, per lb.	.03	.03	.035	.035
Brick along St. car rail, per lin. ft.	.20	.10	.09	.10
Concrete gutters, per lin. ft.	.60	.35	.39	.375
Brick gutters, ret. walls, per M. bk.	17.00	13.00	13.50	13.50
Cypress retaining gutter walls, M. ft.	30.00	24.00	25.00	25.00
Brick culverts, per M. brick	20.00	14.00	13.50	13.50
8-in. vitrified pipe drains	.30	.25	.26	.25
10-in. " " "	.40	.40	.35	.30
12-in. " " "	.50	.55	.40	.40
Pine box drains, per M. ft.	25.00	20.00	19.00	20.00
Cypress box drains, per M. ft.	30.00	27.00	30.00	30.00
Excavation for roadbed, per cu. yd.	.20	.15	.11	.10
Vit. brick pavement, 1 course gravel sub-foundation, per sq. yd.	1.82	.....	1.92	....
Vit. brick pavement, with intermediate course of hard-burned building or vitrified brick, gravel sub-foundation, per sq. yd.	2.29	.....	2.38	....
Vit. brick pavement, with intermediate course of hard-burned building brick on gravel sub-foundation, per sq. yd.	2.14	.....	2.34	....
Telford macadam pavemt., sq. yd.	1.55	1.55	....	....
Gravel pavement, per sq. yd.	1.45	.....	....	....
Excav., curb walls, gutters, cu. yds.	.40	.15	.11	.10
Resurfacing Willow St., complete	.....	2.13	1.80	1.80
Excavating gravel, per cu. yd.	.....	.20	.10	.10

[1] $2.21, $2.13, $2.47. [2] $2.11, $2.03, $2.35. [3] $2.01, $1.97, $2.23.

HYDRANTS AND GATES.—San Francisco, Cal.—Jno. A. Russell, Clk. Supervisors, informs us that the contract to furnish 500 single and 500 double hydrants complete, also 4-in. gates, 5-in. gates and forgings, as may be ordered from time to time by the chief engineer of the fire department, has been awarded to the Risdon Iron & Locomotive Works, the lowest bidders, at the following prices:

Single hydrants, with 4-in. bend, 4-in. gate and forgings, complete	$22.00
Double hydrants, with 5-in. bend, 5-in. gate and forgings, complete	28.00
4-in. gates, each	5.74
5 " " "	8.74
Forgings, per set	1.00

SEWERS.—Scranton, Pa.—The following bids were received April 4 for the construction of a system of lateral sewers in section A, sewer district No. 5; approximate length, 16,833 lin. ft. of 8, 10, 12, 15, 18, 20, and 24-in. terra cotta pipe; 101 manholes, 29 lampholes and 39 catch basins,, 8.25 cu. yds. masonry for anchorage:

	Per lin. ft.
Flanagan & O'Hara, Scranton, Pa.	$1.60
Fred Hendler, Wilkes Barre, Pa.	1.64
Howley Bros., Scranton, Pa.	1.97
Dunn Bros., Scranton, Pa.	2.03
V. H. O'Hara, Scranton, Pa.	2.10
Fox & Ruddy, Scranton, Pa.	1.85
A. H. Coon & Sons, Kingston, Pa.	1.68
Fahey Bros., Scranton, Pa.	1.85
Jos. Stuart & Co., Scranton, Pa.	1.83
R. C. Mitchell, Plainsville, Pa.	2.20
L. J. Jennings, Scranton, Pa.	1.87
P. J. Cleary, Shenandoah, Pa.	1.74
J. B. Fish, Scranton, Pa.	1.98

BRICK PAVING.—Springfield, O.—W. H. Linn, Cy. Engr., writes us that bids were received April 12 for paving one square on West High St., and the contract was awarded to Ed. Ryan for Hayden block on 6 ins. concrete foundation, at the following prices: Excavation, 30 cts. per cu. yd.; concrete foundation, $2.40 per cu. yd.; abutting curb, 30 cts. per lin. ft.; old curb, reset, 10 cts.; new curb, 60 cts.; paving with Hayden blocks, $1.17 per sq. yd.; total cost, $5,242.

CAST IRON PIPE AND PIG LEAD.—Altoona, Pa.—The water board has received the following bids for a supply of water pipe and pig lead: R. D. Wood & Co.,

Philadelphia, $20.34 per gross ton for 4-in. pipe and $19.84 for 6, 8 and 10-in.; Donaldson Iron Co., Emaus, Pa. (awarded contract), $22 for 4-in. pipe and $19.50 for 6, 8 and 10-in.; F. Hersh & Sons, $3.57 per 100 lbs. for pig lead; C. Y. Schelly & Bro., $3.49; M. S. Young & Co., $3.48; W. H. Taylor & Co., $3.48 (awarded contract).

STREET CLEANING.—Chicago, Ill.—The following bids were received recently for street cleaning for the ensuing year: John S. Cooper, $20.90 per lin. mile; James H. Burke, $20; L. L. Leach & Son, $16; W. C. Reeble, $15.50. We are informed by J. W. Twohig, Secy. Dept. Pub. Wks., that the prices per lineal mile in these bids are the prices for every lineal mile of street swept by the contractor.

SEWERS.—Roselle, N. J.—The contract for constructing the proposed outlet sewer has been awarded to Wm. H. Watters; Clk., G. A. Rawlins; Ch. Engr., Carrol Ph. Bassett. The bids were as follows:

Bids Received at Roselle, N. J., March 29, for Constructing an Outlet Sewer.

	P. Faughnan and M. Wade, Elizabeth, N. J.	H. Harrison & Sons, Newark, N. J.	Rooney & Bergen, Paterson, N. J.	A. Costa and S. E. Folts, Orange, N. J.	James Smith & Son, Easton, Pa.	Wm. H. Watters, Bayonne, N. J.	Henry M. Dowd, Orange, N. J.
18 x 22-in. wooden flume, 430 ft; cut, 3.1 ft.	$1.50	$0.80	$0.65	$1.10	$0.85	$1.25	$0.80
14-in. iron siphon, 700 ft.; cut, 4.1 ft.	2.25	1.25	1.20	2.00	2.30	2.50	2.25
18-in. vitrified pipe, 2,710 ft.; cut, 5.1 ft.	1.46	1.00	.80	.78	.97	1.00	.78
15-in. " " 9,190 " " 8.1 "	1.34	.85	.80	.70	.83	.67	.78
12-in. " " 2,280 " " 13.3 "	1.23	.85	.75	1.10	.90	1.00	.73
10-in. " " 1,200 " " 7.5 "	1.18	.45	.70	.62	.58	.50	.62
15-in. Y's.	2.53	1.25	1.00	1.00	1.00	1.00	1.06
12-in. "	2.04	.65	1.00	1.00	.80	.85	1.06
10-in. "	1.80	.50	1.00	1.00	.70	.65	1.00
Manholes, under 12 ft. deep	2.70	2.25	2.50	2.50	2.00	2.50	2.00
" over 12 " "	2.85	2.75	3.00	3.00	2.30	3.00	2.25
" buckets	.90	2.00	1.00	1.00	1.00	1.00	1.00
Lampholes	1.25	.75	.50	1.00	1.25	1.00	.30
Silt basins	5.00	5.00	5.00	5.00	5.00	4.00	4.00
Concrete	4.50	6.00	4.00	1.00	5.00	1.00	5.00
Iron castings	.03	.015	.03	.015	.04	.03	.015
Cast iron pipe,	28.00	22.50	25.00	15.00	30.00	20.00	50.00
Timber foundation	28.00	20.00	8.00	10.00	30.00	1.50	15.00
Sheathing	28.00	20.00	10.00	10.00	20.00	2.00	6.00
Excavation, below grade	.50	.50	.50	.50	.80	.01	.20
4-in. under drain	1.00	.25	.30	.55	.30	.08	.10
6-in. " "	1.10	.30	.40	.75	.35	.12	.30
Manhole drops	1.50	1.00	1.00	1.00	1.00	3.00	1.00
8-in. piles	1.50	.50	.50	1.00	.50	.50	.50
Masonry at outlet	25.00	15.00	50.00	10.00	50.00	40.00	10.00
Total	$35,054	$20,396	$19,224	$21,067	$21,997	$17,341	$18,403

CULVERTS.—Washington, D. C.—The lowest bid received by the district commissioners last week for the construction of a culvert in Albemarle St. was that of Michael H. Cavanaugh, at $4.90 per cu. yd. for a rubble stone culvert, or $6.40 for brick masonry. There were eight bidders.

CAST IRON PIPE.—Newport, Ky.—The water commissioners have awarded the contract for cast iron pipe for the ensuing year to the Addyston Pipe & Steel Co., at $23 per ton, delivered in any part of the city. The Anniston Pipe Co. bid $22.90 delivered on cars in Newport, and Dennis Long & Co., $23.40.

DAM.—Woonsocket, R. I.—F. A. Caldwell, Asst. Engr., has sent us the following statement of the bids received for constructing dam for proposed storage basin No. 3, as advertised in Engineering News. The vote to award the contract to J. B. Reilly & Co., and the consequent suspension from office of two of the three commissioners, were noted last week under Water-Works. Engr. and Supt., Byron I. Cook:

Bids Received at Woonsocket, R. I., March 27, 1895, for Constructing Dam for Storage Basin No. 3.

Bidder.	Grubbing and clearing land, 17,000 sq. yds.	Excavation in water, 800 cu. yds.	Puddled earth embankment, 33,500 cu. yds.	Dry earth fill, 2,000 cu. yds.	Dressing slopes with loam, 7,400 sq. yds.	Concrete masonry, 2,500 cu. yds.	Rubble concrete masonry, 150 cu. yds.	Rubble mas'ry, 980 cu. yds.	Split-face rubble masonry, 67 cu. yds.	Cut-stone masonry, 30 cu. yds.	Cut-stone arch, 6-10 cu. yd.	Par'g rollway, 80 sq. yds.	Paving apron, 300 cu. yds.	Riprap, slopes, 2,000 cu. yds.	Frame gate house, complete.	2-in. spruce sheeting, 23 M. ft.	Hard pine apron, 1½ M. ft.	Cofferdams per M. ft.	6 x 12-in. H. P. sheet piling, per M. ft.	Iron screens, 300 lbs.	Total.
J. H. Leavitt & Saucier, Boston	$0.04	$0.50	$0.30	$0.25	$0.10	$3.50	$2.50	$4.50	$15.00	$20.00	$30.00	$1.75	$3.75	$1.50	$250.00	$25.00	$40.00	$30.00	$50.00	.....	$32,789
Weand & Lesher, Reading, Pa.	.23	.58	.38	.23	.12	3.30	3.40	3.40	5.30	21.45	23.00	1.04	4.15	1.15	275.00	26.00	40.00	40.00	40.00	$0.07	36,156
McNiece, Cuozzo & Co., New York	.01	.60	.32	.24	.08	3.35	4.20	3.70	5.40	32.50	40.00	.75	2.50	1.65	325.00	27.00	45.00	30.00	50.00	.08	31,586
Troy Public Works, Co., Troy, N. Y.	.15	1.00	.35	.30	.10	3.00	3.00	4.00	6.00	25.00	30.00	1.00	2.00	1.00	250.00	30.00	40.00	50.00	50.00	.10	33,771
*Cumberland Construction Co. and Kenneth McKay.	.15	.50	.30	.25	.15	2.50	2.70	4.00	12.00	35.00	35.00	3.00	4.00	1.75	500.00	40.00	50.00	.....	.....	.10	33,543
Gennaro, Long & Little, South Braintree, Mass.	.16	.60	.285	.25	.09	3.10	3.50	3.75	8.00	18.00	30.00	1.00	3.00	1.50	250.00	22.00	50.00	.....	.....	.03	31,114
Daniel J. Cronin & Co., Boston	.20	1.00	.27	.28	.10	3.50	3.50	4.00	6.00	20.00	30.00	.90	3.00	1.60	400.00	30.00	50.00	35.00	60.00	.10	34,132
Benjamin F. Smith, Pawtucket, R. I.	.30	.75	.35	.25	.10	2.75	3.75	3.75	12.00	55.00	65.00	1.20	2.00	1.25	400.00	48.00	50.00	55.00	60.00	.08	37,077
Lucian A. Taylor, Boston	.09	.85	.40	.25	.12	2.80	2.50	3.50	8.00	15.00	30.00	.80	3.00	1.75	250.00	32.00	47.00	28.00	60.00	.05	34,347
T. B. Staples and Ingerson & Nash, Providence, R.I.	.15	.50	.38	.25	.10	3.50	3.00	3.50	5.00	20.00	30.00	1.00	3.50	1.50	350.00	30.00	40.00	50.00	50.00	.10	35,769
Wellington & Coyne, N. Oxford, Mass., and N.Y. city.	.10	.99	.30	.25	.10	3.70	3.35	3.35	6.25	12.95	16.00	.45	1.60	.90	350.00	25.00	40.00	25.00	55.00	.....	30,938
Feorini, Michilina & Cenedella.	.18	1.75	.35	.175	.10	2.75	2.00	3.45	4.00	18.00	30.00	2.00	1.43	.90	481.00	25.00	27.00	25.00	38.00	15.00	32,170
A. H. Wright & Sons, Springfield, Mass.	.25	1.00	.40	.25	.20	4.00	6.00	4.00	8.00	20.00	25.00	.75	2.00	1.00	400.00	35.00	50.00	35.00	50.00	.06	40,364
John B. Reilly & Co., Trenton, N. J.	.01	.50	.35	.30	.15	3.75	4.00	3.75	7.00	15.00	30.00	.15	3.60	2.00	800.00	25.00	40.00	.....	60.00	50.00	35.170
Newell & Snowlin, Uxbridge, Mass.	.20	.75	.37	.24	.08	4.50	4.00	4.00	15.00	18.00	50.00	1.50	6.00	.50	560.00	24.00	40.00	30.00	150.00	.07	38,934
George P. Warfield, Woonsocket, R. I.	.27	.70	.49	.27	.14	4.85	4.85	4.00	9.00	25.00	30.00	1.50	3.00	1.65	400.00	25.00	35.00	51.00	65.00	.06	46,650
**Geo. M. Atkins & Co., Palmer, Mass.	.15	1.00	.30	.30	.10	2.50	2.50	4.00	10.00	20.00	20.00	1.50	2.00	1.00	600.00	30.00	40.00	15.00	40.00	15.00	30,661

* Central Falls, R. I. ** Bid received too late for consideration.

ASPHALT PAVING.—Brooklyn, N. Y.—Bids were opened April 10 for repaving nine streets, 28,884 sq. yds., with asphalt laid on old cobblestone pavement. N. P. Lewis, Engr. of Local Improvements, writes us that the pavement will consist of 1 in. of coal tar and broken stone binder laid over cobblestone, and 2 ins. of asphalt over that. The ruling prices heretofore have been from $2 to $2.05 per sq. yd. The bids were practically the same for each of the nine contracts, those for one being itemized as follows:

Items.	Eastern Bermudez Asphalt Co.	Fruin-Bambrick Construction Co.	E. J. McKeever & Bro.	T. D. Bradford.	Cranford & Co., Brooklyn.
Asphalt pavement, per sq. yd.	$1.97	$1.69[1]	$1.50[2]	$1.44[3]	$1.60[4]
Repair'g cobblestone, " " "	.20	.25	.28	.28	.28
Resett'g curb, etc., per lin. ft.	.31	.30	.55	.30	.30
Redress'g old curb, per lin. ft.	.20	.20	.28	.20	.20
New curb, per lin. ft.	.70	.65	.00	.65	.60
New bridgestone, per lin. ft.	.40	.40	...	.40	.35
Add'l refagging, per lin. ft.	.20	.25	.05	.01	.03

[1] Trinidad overflow. [2] Rock asphalt. [3] Alcatraz asphalt. [4] Trinidad Lake asphalt, $1.60; Trinidad overflow, $1.35.

WATER-WORKS.—Seneca, Kan.—F. L. Burrell, Engr., writes us that the contract for works, as advertised in Engineering News, has been awarded to Jas. T. Broughal, Kansas City, Mo., at $29,200 for the complete work. Turner & Lake, Clyde, Kan., bid $31,000, and B. P. Eagan, Nebraska City, Neb., $32,476; engineer's estimate, $33,000. The bids ranged as follows: 66 ins. x 14-ft. boilers, 2, $1,317 to $1,495; pumps, 2, $1,265 to $2,840; 150-HP. heater, $184 to $260; stand-pipe, $2,200; hydrants, 33, $18.75 to $24 each; pipe, $21.90 to $23.90 per ton; special castings, 2 cts. to 2.65 cts. per lb.; lead, 3.18 cts. to 3.25 cts. per lb.; yarn, 4½ cts. to 5 cts. The bids for valves and boxes were as follows:

	4-in.	6-in.	8-in.	10-in.	Bxs.
Ripley & Detrick Co.	$6.25	$9.50	$16.00	$23.00	$2.50
Crane Co	5.50	9.25	14.90	23.50	3.45
Rensselaer Mfg. Co.	6.80	11.00	17.00	23.00	2.75
U. S. W. & S. Supply Co.	6.00	9.75	15.00	20.50	....
R. D. Wood & Co.	7.25	12.00	18.00	25.00	2.75

WATER-WORKS SUPPLIES.—Richmond, Va.—E. E. Davis, Secy. Com., wites us that the committee on water has awarded the following contracts for supplies: Smith-Courtney Co., double-nozzle 4-in. fire hydrants, 30, at $20.65; brass work, $610, lump sum; Southern Railway Supply Co., 4-in. gate valves (Stevens-Roe), 10, at $5.50; 6-in., 25, at $8.80; 8, 10, 12, and 20-in., such as may be ordered, at $14.30, $20.90, $27.50 and $105, respectively; Glamorgan Co., 4-in. cast iron pipe, $19.40 per ton of 2,240 lbs.; 6-in., $18.90; 8 to 36-in., $18.40; Tredegar Co., special castings, 18,000 lbs., 1.95 cts. per lb.; large stop-cock boxes, 35, at $4.75; small stop-cock boxes, 700, at 55 cts.; Courtney Supply Co., wiping solder, 800 lbs., 8.19 cts. per lb.; Geo. B. Gaines & Co., pig lead, 8,000 lbs., 3.48 cts. per lb.

CEDAR BLOCK PAVING.—Green Bay, Wis.—E. Nebel, St. Supt., writes us that a contract for $17,000 worth of paving with cedar blocks has been awarded to a Minneapolis firm, at 76 cts. per sq. yd., and that no other work is contemplated at present. Engr., D. C. Gayton.

BRICK PAVING.—Peoria, Ill.—A. D. Thompson, Asst. Engr., writes us that the following contracts were awarded April 4 for paving several streets with one course of small brick on 6 ins. broken stone concrete foundation and alleys with similar pavement on 4 ins. broken stone concrete foundation:

Street.	Lowest bidder.	Paving, per sq. yd.	Excavation, per cu. yd.	Set'g curb, per lin. ft.	Total.
Third Ave. (Sec. 1)	J. J. Jobst	$1.32	$0.22	$0.06	$11,526
" " (Sec. 2)	J. J. Jobst	1.32	.22	.06	1,726
Madison Ave.	Robt. Clark	1.20	.25	.06	4,551
Chestnut St.	Robt. Clark	1.30	.25	.06	4,166
Spring St.	J. Deal & Co.	1.33	.22	.06	2,687
California Ave.	*Tibt Peg Co.	1.34	.20	.06	4,028
Liberty St.	Robt. Clark	1.30	.25	.06	7,066
Commercial St.	Robt. Clark	1.30	.25	.06	1,729
Alley block 38	J. J. Jobst	1.32	.22	.06	1,042
" " 43	J. J. Jobst	1.32	.22	.06	1,060

* Talbot Paving Co., Detroit, Mich.; all others of Peoria.

BRICK PAVING AND SEWER.—Averyville, Ill.—Harman & Evans, Engrs., Peoria, Ill., write us that the following bids were received April 5 for the improvement of Galena Road:

Quantities.	Day & Daugherty, Sup'r, Canton, Ill.	John Traft, Dayton, Ky.	Talbot Paving Co., Detroit, Mich.	James Deal & Co., Peoria, Ill.
Excavation 8,688 cu. yds.	$0.27	$0.18	$0.18	$0.26
Curbing* 11,278 lin. ft.	.39	.395	.36	.35
Prot. curb'g* 750 " "	.49	.35	.28	.30
Paving** 25,150 sq. yds.	1.39	1.31	1.24	1.32
Cross pl., 5-ft., 60	6.15	13.50	5.00	3.15
" " 7-ft., 32	8.35	22.38	6.00	6.25
Sewer inlets 9	6.00	12.00	10.00	4.00
" " 9	15.50	17.50	5.00	14.00
24-in. sewer, 450 ft.	1.15	1.30	.94	.87
20-in. " 800 "	.85	.89	.60	.65
15-in. " 1,400 "	.60	.55	.55	.55
12-in. " 400 "	.55	.49	.30	.45
Manholes ... 9	19.00	19.00	15.00	30.00
Total	$45,220	$43,331	$39,260	$42,214
Add for stone concrete	1,509	2,012	754	754
Deduct for sandstone curb'g	....	327	902	....

* Limestone.
** Paving with one course of small brick upon 6 ins. gravel concrete foundation.

SEWERS.—Malden, Mass.—G. A Wetherbee, Cy. Engr., informs us that the following bids have been received for building portions of the sewerage system:

Sections 1, 2, 4, 5, 6, 8.	J. N. Drew & Co.	Weaving Booth & Co.	A. W. Bryne.	F. L. Allen.
Excav., 8 ft. dp. 27,522 cu. yds.	$0.05	$0.90	$0.65	$0.70
8 to 12 ft. dp. 4,085 " "	.10	1.12	.80	1.00
12 " 16 " "	1.50	4.00	1.00	2.00
20-in. pipe, laid 50 lin. ft.	1.25	.50	.25	.25
18-in. " " 150 " "	1.00	.30	.20	.20
15-in. " " 1,230 " "	.70	.25	.15	.15
12-in. " " 946 " "	.60	.25	.15	.15
10-in. " " 1,614 " "	.55	.20	.10	.15
8-in. " " 21,053 " "	.54	.15	.10	.15
6-in. " " 5,950 " "	.50	.10	.10	.10
Brick masonry, 571 cu. yds.	6.00	6.50	6.00	6.00
Concrete mas., 116 " "	6.00	6.00	5.00	5.00
Lumber, 62.9 M. ft.	35.00	50.00	40.00	45.00
Paving, 356 sq. yds.	3.00	3.00	3.00	3.00
Total	$26,064	$42,695	$31,988	$35,639

Sections 6, 8, 9, 10, 11, 14.	J. N. Drew & Co.	A. W. Bryne.	F. L. Allen.	Lindsey & Cudmore.
Excav., 8 ft. dp. 27,204 cu. yds.	$0.05	$0.60	$0.58	$0.58
8 to 12 ft. dp. 7,379 " "	.05	.80	.95	.75
12 " 16 " " 1,930 " "	.05	.90	1.50	1.00
16 " 20 " " 564 " "	.05	1.20	2.00	1.25
20 " 26 " " 370 " "	.05	1.50	2.50	2.00
18-in. pipe, laid 1,085 lin. ft.	1.00	.20	.25	.05
15-in. " " 1,300 " "	.90	.15	.20	.05
10-in. " " 1,174 " "	.80	.10	.20	.05
8-in. " " 16,270 " "	.70	.10	.20	.05
6-in. " " 7,581 " "	.58	.10	.10	.05
6-in. chimneys, 670	.20	.20	.05	.05
Brick masonry, 916 cu. yds.	8.00	6.00	5.50	4.00
Concrete mas., 477 " "	6.00	5.00	4.75	3.00
Lumber 11.2 M. ft.	35.00	40.00	40.00	35.00
Paving 356 sq. yds.	3.00	3.00	3.00	3.00
Total	$32,637	$37,640	$41,368	$32,647

CASTINGS.—Detroit, Mich.—The water board received six bids for about $8,000 worth of sand or loam castings for a 42-in. water main, the contract being awarded to Samuel F. Hodge & Co., at 2¼ cts. per lb.

CAST IRON PIPE.—Brooklyn, N. Y.—The following bids were received April 11 for furnishing 1,550 tons of 30-in. and 250 tons of 20-in. cast iron water pipe, and 43 tons of special castings, for an extension of the Bushwick Ave. main, as advertised in Engineering News:

	Pipe, per ton.	Specials, per lb.
R. D. Wood & Co.	$20.40	$0.02¼
Anniston Pipe & Foundry Co.	19.50	.01⅞
Warren Foundry & Machine Co.	19.20	.02
Reading Foundry Co.	19.04	.02
McNeal Pipe & Foundry Co.	18.90	.02

BRIDGE.—Indianapolis, Ind.—Bids were opened April 9 for the construction of a girder bridge on Raymond St. over Pleasant Run, and one on Pratt St. over the canal. The first is 78 ft. span, 7 ft. 6 ins. depth of girder, with floor beams 30 ft. x 36 ins. x 5-16 in., and I-beams 15 ft. x 12 ins., 38 lbs. weight per ft., and double 1½-in. oak floor, designed to carry a live load of 100 lbs. per sq. ft. on the above roadway and 80 lbs. on sidewalks, to be put on at some time in the future, and a dead load of the bridge and floor. The second is 66 ft. x 6 ft., with floor beams

24 ft. × 30 ins., and I-beams 14 ft. 6 ins. × 12 ins., 41 lbs. per ft. weight, designed for 100 lbs. per sq. ft. and a 12-T roller and a dead load of the bridge and a floor weighing 12 lbs. per ft. The bids on the Raymond St. bridge were as follows: Rochester Bridge & Iron Co., $3,347; Wrought Iron Bridge Co., $3,150; New Columbus Bridge Co., $3,150; Massillon Bridge Co., $3,000; Indiana Bridge Co., of Muncie, $2,800; Toledo Bridge Co., $2,690; Youngstown Bridge Co., $2,668; American Bridge Works, of Chicago, $2,631; J. D. Adams & Co., of Indianapolis, $2,580. The contract has not yet been awarded. The bids on the Pratt St. Bridge were as follows: Rochester Bridge & Iron Co., $1,828; Wrought Iron Bridge Co., $1,880; New Columbus Bridge Co., $1,575; Toledo Bridge Co., $1,540; Massillon Bridge Co., $1,525; American Bridge Co., $1,498; J. D. Adams & Co., $1,480; Indiana Bridge Co., $1,415; Youngstown Bridge Co., $1,413. The last named received the contract.

CARBONS.—Jacksonville, Fla.—The following bids were received for furnishing 50,000 ½-in. copper-coated carbons, f. o. b.:

	Per M.
American Carbon Co., Dayton, O.	$7.53
General Electric Co., New York	8.25
Standard Carbon Co., Cleveland, O.	9.00
Washington Carbon Co., Pittsburg, Pa.	7.65
Boulton Crown Carbon Co., Tonawanda, N. Y.	8.75
Brush Carbon Works, Cleveland, O.	12.00
National Carbon Co., Cleveland, O.	11.00

RIVER IMPROVEMENTS.—Savannah, Ga.—Capt. O. M. Carter, U. S. Engineer Office, received the following bids April 6 for river and harbor improvements:

Items.	Cordes & Bochman, Charleston, S. C.	Chas. C. Ely, Savannah, Ga.	Wm. T. Gaynor, Fayetteville, N. Y.
Mattresses, per sq. yd.	$1.20	$1.28	$1.00
Fascines, per cu. yd.	1.75	1.85	1.65
Pile work, per lin. ft.	1.60	1.75	1.50
Fender piles, per cluster	75.00	60.00	50.00
Tie piles, per group	25.00	25.00	20.00
Sawed timber, per M. ft. B. M.	30.00	30.00	25.00
Iron bolts, per lb.	.05	.06	.05
Riprap stone, per cu. yd.	3.25	4.00	3.05
Total	$52,625	$59,425	$48,000

SEWERS.—Keokuk, Ia.—W. H. Jones, Cy. Engr., informs us that the following bids were received April 1 for the extension of the main sewer, as advertised in Engineering News:

THE JACKSON & WOODIN MFG. CO., of Berwick, Pa., has a contract for 150 box cars of 60,000 lbs. capacity for the Delaware & Hudson R. R.

THE PITTSBURG LOCOMOTIVE WORKS, of Pittsburg, Pa., has an order for six heavy ten-wheel freight engines for the Pittsburg & Lake Erie R. R.

THE COATES MFG. CO., of Columbus, O., has an order for its oil fuel burners for the locomotives of the St. Louis Merchants Bridge Terminal Ry. Co., of St. Louis, Mo.

THE LODGE & DAVIS MACHINE TOOL CO., of Cincinnati, O., has opened a branch store at 720 North Second St., St. Louis, Mo. J. W. Wright is in charge of this branch.

THE BLOOMSBURG CAR WORKS, of Bloomsburg, Pa., has an order from Flint, Eddy & Co., of New York, for 200 coal cars, 50 box cars and 25 platform cars for Brazil.

THE SCAIFE FOUNDRY & MACHINE CO., of Pittsburg, Pa., has supplied a number of rolls for the new extension of the plant of the Elliott-Washington Steel Co., of New Castle, Pa.

THE DANIELS STEEL RAILWAY TIE CO., of Youngstown, O., has elected the following officers: Pres. and Gen. Man., Thomp Burton; Vice-Pres., Lemuel O. Ohl; Secy., C. A. Smith.

THE EDGE MOOR BRIDGE WORKS, of Wilmington, Del., has the contract for a foundry and machine shop, 52 × 250 ft., for William Wharton, Jr., & Co., at 23d St. and Washington Ave., Philadelphia, Pa.

THE BARNEY & SMITH MFG. CO., of Dayton, O., is building the motor and trail cars of the Nantasket branch of the New York, New Haven & Hartford R. R., 9 miles long, which is to be operated by electricity.

THE WAUKEGAN PIPE LINE SERVICE CO., of Chicago, Ill., has been incorporated by Elmer W. Atkinson and David M. Ball, Opera House Block, to establish plants for cooling drinking water without the use of ice; capital stock, $200,000.

THE SOUTH BALTIMORE CAR WORKS, of Baltimore, Ind., has an order for 15 of the Campbell & House combination stock and freight cars, 10 for the Baltimore & Ohio R. R. and five for the Mather Stock Car. Co. We shall illustrate one of these cars soon.

THE DETROIT BRIDGE & IRON WORKS, of Detroit, Mich., has the contract for the steel transfer bridge for a car transfer at Gladstone, Mich., for the Toledo, Ann Arbor & North Michigan R. R. James Turnbull, of Owosso, Mich., is building the slip for the railway company.

THE BERLIN IRON BRIDGE CO., of East Berlin, that it can be closed up to be put in place, and will then open out to the full width between the rail webs, while at switches the guard will become narrower or wider, according to the movement of the switch rail.

THE SHIFFLER BRIDGE CO., of Pittsburg, Pa., furnished the roof trusses for the new court house at Minneapolis. The construction of the roof is now being completed by Rinker & Hoff, of Minneapolis, Northwestern representatives of the Shiffler Bridge Co. We are informed that the work was commenced by the Gillette-Herzog Mfg. Co. a couple of years ago and about one-third completed. The remaining two-thirds of the work is not being done by that company, as was stated in our item of April 4.

THE BALDWIN LOCOMOTIVE WORKS, of Philadelphia, Pa., has undertaken the construction of trucks for electric cars as a branch of its regular business, and is now building 32 trucks for the 9-mile Nantasket electric branch of the New York, New Haven & Hartford R. R. Each car will have two trucks, with 36-in. wheels and 6 ft. 6 ins. wheel-base, each truck having a General Electric motor. The Baldwin Works also built the trucks for the cars of the Metropolitan Electric Elevated Ry., of Chicago.

PENMAN & BROWN is the new firm name of the East Chicago Tank & Boiler Works, of East Chicago, Ind., as Wm. H. Penman, formerly sole proprietor, has formed a partnership with Morton O. Brown. The scope of the business will be enlarged, and will include the manufacture of water-works stand-pipes, boilers, smokestacks, tanks, etc. New punching machines, rolls and other machinery will probably be added to the plant. The firm has recently been awarded a contract for a water-works stand-pipe at Decatur, Mich.

THE UNITED STATES WIND ENGINE & PUMP CO., of Batavia, Ill., has recently been awarded contracts for putting in complete water supply systems at the following places: Brightwood, Ind.; Valley City, N. Dak.; Long Prairie and Elysiam, Minn., and Dayton, Ia. Mr. Snow informs us that there is a good outlook for increased trade, and that the company is receiving some orders for its railway department, particularly for the Mansfield water column, which is now in use on about 20 railways, including the Chicago & Northwestern, New York, Lake Erie & Western, and others. There is some activity in the foreign trade, and the company is now building a 40-ft. wheel for a wind engine to be shipped to England.

THE PENNSYLVANIA STEEL CO. is having its affairs straightened out, and the reorganization committee of the Pennsylvania Steel Co. and Maryland Steel Co. has announced to the creditors of the Pennsylvania Steel Co. that a decree has been made order-

Bids Received April 1 for the Extension of Main Sewer, Keokuk. Ia.

Bidder.	Work in open cut. Earth excav., 390 cu. yds.	Rock excav., 912 cu. yds.	Riprap diff'g, 1,040cu.yds.	Brick mas., in place, 330 cu. yds.	Stone mas. in place, 68 cu. yds.	Backing in place, 53 cu yds.	Concrete in place,617 cu. yds.	Brick bottom in place, 245 sq. yds.	Concrete bottom in place, 117 sq. yds.	Timber in place, 50 M. ft.	Drift bolts in place, 500 lbs.	Tunnel. Portal and wing walls, complete.	*Tunnel, 87 sec., 550 lin. ft.	Brick mas., in place, 520 cu. yds.	Backing in place,390 cu. yds.	Concrete in place. 85 cu. yds.	Concrete bottom in place, 500 sq. yds.	Timber in place, 18 M. ft.	Drift bolts in place, 538 lbs.	Total.
Andrew Onderdonk, Chicago, Ill.	$0.70	$1.25	$0.30	$10.00	$4.00	$3.50	$4.00	$2.00	$1.75	$24.00	$0.04	$300.00	$15.00	$9.00	$3.00	$4.00	$1.50	$24.00	$0.04	$27,953
Fruin-Bambrick Const'n Co., St. Louis	.38	1.10	.55	8.80	5.50	4.40	6.60	2.20	2.20	22.00	.04	605.00	18.15	11.00	5.20	6.60	2.20	22.00	.04	32,631
N. S. Young, Burlington, Ia.	.75	1.00	.65	8.00	5.00	4.00	4.00	2.50	2.00	40.00	.05	560.00	16.65	9.00	5.00	5.50	2.50	40.00	.05	31,424
Kissack & Muir, Chicago, Ill.	1.75	.90½	.37	7.11	5.40	4.50	4.50	2.16	1.80	20.25	.04	325.00	13.59	8.80	4.50	4.50	1.80	20.25	.04	30,627
George Krichbaum, Burlington, Ia.	.50	2.50	.60	8.00	5.00	3.00	5.00	3.75	1.75	22.00	.02½	500.00	25.00	10.00	4.00	6.00	2.50	22.00	.02½	36,100
**James Cameron & Co., Keokuk, Ia.	.92	.94	.22	8.56	3.03	2.75	3.03	1.87	1.60	24.20	.02 1-5	295.50	15.40	9.25	2.75	3.00	1.54	24.20	.02 1-5	27,316
Rockford Construction Co., Rockford, Ill.	.50	2.00	.50	7.00	5.00	4.00	3.00	1.70	1.10	25.00	.05	700.00	22.50	8.50	4.50	4.00	1.25	25.00	.05	31,119
James O'Loughlin, Chicago, Ill.	.30	3.00	...	6.00	3.00	2.00	3.50	2.00	1.00	28.00	.05	400.00	30.00	8.00	3.00	3.00	1.00	22.00	.05	33,598
C. A. McNamara & J. C. Tigue, Keokuk, Ia	.44	1.65	.33	9.00	3.50	3.00	3.75	3.50	3.00	18.00	.03½	675.00	32.50	9.75	3.00	3.50	3.00	18.00	.03½	38,156
T. B. Townsend Co., Zanesville, Ohio.	.68	1.56	.63	8.40	3.13	3.13	3.13	2.13	.63	18.75	.04	287.50	17.50	10.63	6.25	3.13	.63	18.75	.04	29,677
Shaller & Schniglau Co., Chicago, Ill.	.40	1.20	.40	8.00	5.00	5.00	4.00	2.50	1.00	30.00	.04	400.00	19.50	8.75	5.00	4.50	1.00	20.00	.04	29,594
Dubuque Construction Co., Dubuque, Ia.	.60	1.25	.38	9.35	3.45	3.75	3.50	2.10	1.50	25.00	.07	600.00	22.50	11.50	5.00	3.75	1.75	25.00	.07	33,747

* Tunnel, average section contains 5 cu. yds. per lin. ft. ** Contract awarded.

MANHOLE FRAMES AND COVERS.—Medford, Mass.—T. Howard Barnes, Cy. Engr., writes us that the following bids were received March 30 for manhole frames and covers, as advertised in Engineering News; the weight of cover and frame being 416 lbs.:

Fairhaven Iron Foundry Co., Fairhaven, Mass.	$4.68
Osgood & Hart, 3 Sherman St., Charlestown	4.75
Union Iron Works, Lynn, Mass.	4.78
Henry Parsons, Marlboro, Mass.	4.90
The Pratt & Cady Co., Hartford, Conn.	4.95
Bradley, Hastings & Co., Boston, Mass.	4.98
Mechanics' Iron Foundry Co., Boston, Mass.	4.99
Lynn Foundry & Mfg. Co., Lynn, Mass.	4.99
F. B. Hawkins & Co., 29 Broadway, New York	5.10
Noble Stove Co., Lynn, Mass.	5.14
Le Baron Iron Foundry, Middleboro, Mass.	5.17
Davis Foundry Co., Lawrence, Mass.	5.45
Thos. J. McKenna, 35 Broadway, New York	6.29
L. H. Goodnow, Fitchburg, Mass.	6.37
John Fox, 160 Broadway, New York	6.45
Davies & Thomas Co., Philadelphia, Pa.	6.45
Builders' Iron Foundry, Providence, R. I.	7.35
Whittier Machine Co., 53 State St., Boston	9.25
James A. Colvin, Worcester, Mass.	9.35
McNeal Pipe & Foundry Co., Burlington, N. J.	9.36

WATER-WORKS SUPPLIES.—Hamilton, O.—The following were the lowest bids received for furnishing supplies for the water department during the ensuing year: Wood, Vallance & Co., 12 tons ½-in. lead pipe, at $4 per 100 lbs.; J. Robertson & Co., Toronto, 12 tons pig lead, $2.70 per 100 lbs.; A. Gartshore, cast iron pipe, $30.75 per ton; castings (junctions, bends, etc.), 2¼ cts. per lb.; 12-in. stop valves, 7, at $32; 6-in., 50, $12; Nie & Whitfield, ordinary castings, 1.87 cts. per lb.; iron stopcock boxes, 50, $1.22 each; Hamilton Brass Co., service brass work, $1,203.

INDUSTRIAL NOTES.

THE UNION CAR CO., of Depew, N. Y., is building 100 refrigerator cars for the Chilean Government Railways.

W. J. ADAMS, of Joliet, Ill., is manufacturing a fence post of T-iron, with inclined slots or notches to receive the fence wires.

ATKINS BROS., of Oskaloosa, Ia., may remove their bridge works from Creston to Burlington, Ia., where a site has been offered.

Conn., has furnished the iron roof trusses and purlins for the new electric light station at Marblehead, Mass., and has an order from the Clyde Steamship Co. for its new pier shed, which will be 344 ft. long and 124 ft. wide, entirely of iron.

THE ELECTRIC POWER STORAGE CO., of New York, N. Y., has secured an order through W. Hood, its Chicago agent, for accumulators of 350 ampere-hour capacity for lighting the summer residence of H. H. Porter, President of the Chicago & Eastern Illinois R. R., at Lake Geneva, Wis.

GUILD & WHITE, engineers and contractors, of Chattanooga, Tenn., have contracts for water-works at Carrollton, Ky., and Vevay, Ind., which are nearly opposite each other, on the Ohio River; and are also building water works at Paris, Tenn. They have nearly completed the works at Morganfield, Ky.

THE NATIONAL SWITCH & SIGNAL CO., of Easton, Pa., has been awarded the contract for interlocking a junction on the Manhattan Beach Division of the Long Island R. R., also two crossings of the Nassau Electric Ry. with the Long Island R. R. at Atlantic Ave., Brooklyn, and Rockaway Ave., Flatlands.

THE HAVANA BRIDGE WORKS, of Montour Falls, N. Y., has been organized by Robert T. Turner and Charles R. Root, of Elmira, N. Y., and James A. Shepard, of Montour Falls. The capital stock is $30,000, and the company will acquire the plant of the Shepard Bridge Works, recently sold under foreclosure proceedings.

THE CATSKILL SHALE BRICK & PAVING CO., of Catskill, N. Y., has increased its capital stock to $500,000, and will undertake contracts for paving, as well as for supplying paving brick. Pres., R. C. Penfield, Willoughby, O.; Vice-Pres., Hewitt Boice, Kingston, N. Y.; Treas., O. M. Stafford, Cleveland, O.; Gen. Man. and Secy., pro tem, J. F. Harris, Catskill, N. Y.

M. F. McCARTHY, Chicago, Ill., is putting his patent wire and concrete floor into the Lincoln Park Palace apartment house, and the Kenwood Hotel, Chicago. There are 70,000 sq. ft. and 80,000 sq. ft. of the flooring used in these buildings, respectively. This flooring, as applied to a large foot bridge in Lincoln Park, Chicago, was illustrated and described in our issue of April 4.

THE NATIONAL RAILWAY FOOT GUARD CO., of Columbus, O., is bringing out a new form of foot guard for use at frogs, switches, etc. The guard is of sheet steel, in two parts, connected by springs, so

ing a sale, on May 15, of the assets of that company, at public auction, in Philadelphia, Pa., and that as soon as possible after the confirmation by the court of this sale, the committee expects to be able to commence the work of settling with the creditors upon the terms of the agreement of June 9, 1894. More definite information as to when the settlement may be expected will be given by the committee as soon as it is in a position to do so.

NEW COMPANIES.—W. H. Hill Lime Cement Co., East St. Louis, Ill.; $25,000; Wm. H. Hill and H. W. Hill.

Murphy & Lorimer Brick Co., Chicago, Ill.; $40,000; Wm. J. Murphy and William Lorimer.

Bradley Filter Co., Syracuse, N. Y.; $50,000; C. C. Bradley, W. C. Bradley and C. S. Bunnell.

Phoenix Foundry Co., Galena, Kan.; $2,000, all paid in; J. H. Jones, J. R. Ranch and W. H. Self.

Mexican Exposition Construction Co., Chicago, Ill.; $100,000; Normand S. Patton, Morris G. Holmes and J. A. Johnson.

Gem City Paving Brick Co., Riverside, Ill.; $30,000; William S. Warfield, Chauncey H. Castle and Ellridge F. Stone, Jr.

Wiseman's Automatic Safety Railway Switch Co., Chicago, Ill.; $1,000,000; Theodore Wiseman, Thomas H. Kelley and A. L. Coe.

Roth Multi-Cylinder Motor Co., Cincinnati, O.; gas and electric engines and locomotives; $100,000; Gilson W. Roth, J. M. Blair and R. C. Bliss.

Conshohocken Galvanizing Co., of Conshohocken, Pa.; $50,000; James E. Salter, of Philadelphia, Pa.; Louis N. Lukens and Henry M. Tracy.

Columbia Architectural Iron Works, Greenburg, N. Y.; $50,000; William F. Roehigh, of Brooklyn, N. Y., and Henry H. Royce, of Crawford, N. J.

Ironville Construction Co., Camden, N. J.; $100,000, with $10,000 paid in; W. R. Cason, of Camden, N. J.; W. A. Brazell and Casper Becker, of Philadelphia.

Moen Improvement Co., Jersey City, N. J.; $500,000, with $10,000 paid in; S. Shortridge, of Jersey City, and Eugene R. Leland and Edward R. Thomas, of New York city.

Standard Fireproofing Co., Woodbridge, N. J.; $300,000, with $25,000 paid in; R. C. Penfield, Willoughby, O.; G. D. Beattys, Brooklyn, N. Y.; W. L. B. G. Allen, New York, N. Y.

Washington Dredging & Improvement Co., Seattle, Wash.; $3,000,000; W. Morrison, William Hayes and Frank Shay; to fill in tide flats and build a ship canal from Ellicott Bay to Lake Washington.